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ON THE NUDIBRANCHIATE GASTEROPOD MOLLUSCA OF THE NORTH
PACIFIC OCEAN, WITH SPECIAL REFERENCE TO THOSE OF ALASKA.

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PART I.

The fauna of the North Pacific in general has been but little explored. The number of the so-called Nudibranchiate Gastropod Mollusca found in this region up to this time is rather small. But a few species have been mentioned or described, chiefly by Tilesius, Eschscholtz, and Gould, and the number of forms is much smaller than that which is known from the North Atlantic in the same latitudes. There does not, however, seem to be any reason for a smaller number in the Pacific than in the Atlantic.

Mr. Dall has been engaged since 1865 in prosecuting researches in regard to the marine invertebrates of the region lying between America and Asia, from latitude 50° to latitude 70° N., including the coasts of Alaska, formerly Russian America, the Aleutian Islands, Bering Sea and Strait, and a part of the Arctic Ocean north of the strait.

Mr. Dall kindly invited me, who during a series of years have been engaged with studies upon Nudibranchiates, to examine and describe the collections relating to this group; these were received in the summer of 1876. It has been necessary to include, for comparison, the results of the examination of some few Atlantic species. Dall did not give particular attention to the Nudibranchs; yet, while a comparatively small number of forms and specimens have been obtained during his cruises, the number is sufficient to give some idea of the character of this particular fauna and to enrich our knowledge of the groups with several new forms. This will be obvious from the following list:—

NUDIBRANCHIATA OF THE NORTH PACIFIC.

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| 1. <i>Aeolidia papillosa</i> (L.). | 4. <i>Flabellina iodinea</i> (Cooper). |
| 2. <i>Aeolidia</i> (? var.) <i>pacifica</i> , Bergh,
n. sp. ? | 5. <i>Hermisenda opalescens</i>
(Cooper). |
| 3. <i>Coryphella</i> , sp. | |

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| 6. <i>Fiona marina</i> Försk., var. <i>Pacificica</i> , Bergh. | 17. <i>Acanthodoris pilosa</i> (O. F. Müller), var. <i>purpurea</i> , Bergh. |
| 7. <i>Dendronotus purpureus</i> , Bergh, n. sp. | 18. <i>Acanthodoris coerulescens</i> , Bergh, n. sp. |
| 8. <i>Dendronotus Dalli</i> , Bergh, n. sp. | 19. <i>Lamellidoris bilamellata</i> (L.), var. <i>pacifica</i> , Bergh. |
| 9. <i>Tritonia tetraquetra</i> (Pallas). | 20. <i>Lamellidoris varians</i> , Bergh, n. sp. |
| 10. <i>Archidoris Montereyensis</i> (Cooper). | 21. <i>Lamellidoris hystericina</i> , Bergh, n. sp. |
| 11. <i>Diastylis Sandiegensis</i> (Cooper). | 22. <i>Adalaria pacifica</i> , Bergh, n. sp. |
| 12. <i>Cadlinarepanda</i> (Ald. & Hanc.). | 23. <i>Adalaria virescens</i> , Bergh, n. sp. |
| 13. <i>Cadlina pacifica</i> , Bergh, n. sp. | 24. <i>Adalaria albopapillosa</i> (Dall). |
| 14. <i>Chromodoris Dalli</i> , Bergh, n. sp. | 25. <i>Akiodoris lutescens</i> , Bergh, n. sp. |
| 15. <i>Chromodoris californiensis</i> , Bergh, n. sp. | 26. <i>Triopa modesta</i> , Bergh, n. sp. |
| 16. <i>Acanthodoris pilosa</i> (O. F. Müller), var. <i>albescens</i> , Bergh. | 27. <i>Polycera pallida</i> , Bergh, n. sp. |

An examination of the foregoing list¹ first shows a quite northern character of the forms examined, excepting the two species of *Doridæ* (*Chromodoris*) which actually come from and are usually characteristic of a more southern region than the others. Secondly, the species examined agree with North Atlantic forms, being either identical or mere varieties of them, or at least nearly allied species.²

ÆOLIDIIDÆ.

The *Æolidiidae*³ have representatives in all the seas of the world, but seem, as far as can be judged from the rather meagre accounts

¹ Besides Nudibranchs, there were included in the material sent also a *Marsenia*, an *Onchidiopsis*, a *Gasteropteron*, three or four species of *Bulidæ*, and a *Pleurobranchus*, which will be published later.

² According to R. E. C. Stearns a striking feature in the conchological fauna of that part of the Pacific coast included in the Californian and Oregonian zoological provinces, when compared with the molluscan fauna of the Atlantic coast from the Arctic seas to Georgia, is the preponderance in the former of those forms of molluscan life which are embodied in the *Scutibranchiata*; cf. Proc. Cal. Acad. Sci., Oct. 1872, and Ann. Mag. Nat. Hist., 4th ser., xii. pp. 185-186, 1873.

³ The generic name (*Æolus* Virgil) was established by Cuvier (in the Tabl. Élém. p. 388, 1798), and originally written "Æolide (*Æolidia*);" on the fifth plate of the illustrations of the Léc, d'anat. comp., vol. i., it is written *Eolia*; later, in the Règne Animal, he changed the denomination to *Eolidia*, since then the name has been written *Eolis*, *Æolis* (Lam'k, Lovén,

of them, to be less abundantly distributed through the warm and tropical regions. This seems evident from the information given by Van Hasselt, Kelaart, Alder and Hancock, Collingwood and Pease, as well as by Semper.¹ Van Hasselt has only three forms of *Aeolidiidae*, Elliott (Alder and Hancock) four or five, Kelaart nine. Collingwood was rather astonished at the small number of species and individuals which were found on the coasts of China: Formosa, Labuan, and Singapore, and which included no *Aeolidiidae* at all. The Pacific seems especially poor in *Aeolidiidae*, particularly in its northern and eastern part. The exploration of Alaska, under the direction of Mr. W. H. Dall, has only furnished five or six forms of this group belonging to the genera *Aeolidia*, *Fiona*, *Coryphella*, *Flabellina*, and *Hermisenda*.

I. AEOLIDIA, Cuvier.

Aeolidiana Quatrefages, Ann. Sci. Nat. Zoöl., Sér. i, t. iii. p. 134, 1844.

Aeolidia (Cuvier), R. Bergh, Anat. Bidr. til Kundsk. om Aeolidierne, Danske Vidsk. Selsk. Skr. 5 R. vii. 1864, p. 199.

Aeolidia, R. Bergh, Beitr. zur Kenntn. der Aeolidiaden, I. Verh. der K. K. zoöl.-bot. Ges. in Wien, xxiii., 1873, pp. 618-620; ii. l. c. xxiv. 1874, pp. 395-396.

Corpus sat depressum, rhinophoria simplicia, papillæ² caducæ, compressæ. Podarium antice angulatum mandibulæ applanatæ, processu masticatorio non denticulato. Radula dentibus uniseriatis, regulariter arcuatis, pectiniformibus instructa.

This genus is easily distinguished by its depressed form, the simple rhinophoria, the flattened papillæ, and the straight front margin of the foot, with nearly rounded edges. The mandibles are rather short, very much flattened, the cutting edges simple;

Menke), *Eolida*, *Eolidia*, and *Aeolidia* by different authors. It may be best, as I have done for many years, to adhere to the original Cuvierian way of writing it. Cf. my Unders. af *Fiona atlantica*, Natur. Hist. Foren. Vdsk. Meddel. for 1857, p. 276, 1858.

¹ Cf. my Malacol. Untersuch. (Semper, Reisen im Archipel. der Philip-pines II. ii.) Heft 1, 1870, p. 1.

² I always use the term *papillæ* instead of the more usual one of *branchiæ* or *cirrhi*, partly because it is the Linnean term, partly because the organs do not exclusively serve for respiration, which is partaken of by the whole surface of the skin, that over the papillæ as well as elsewhere, among all the *Nudibranchiata*.

the teeth of the radula comb-shaped, not emarginated in the middle. The genus is unarmed.

The spawn of the typical species is known,¹ and something of the development.

Only a few species of this genus are hitherto known, and very likely the Pacific forms will not prove specifically distinct from the typical species, which is found widely spread over the northern part of the Atlantic, on the coasts of America as well as of Europe.

1. *Aeolidia papillosa* (L.).

Gould, Inv. Mass., ed. Binney, p. 240, Pl. XVIII. f. 258, 1870.

Meyer and Möbius, Fauna der Kieler Bucht, I. p. 29, f. 9, 10, 1865.

Hab. Oc. Atlant. septentr.

2. *Aeolidia serotina*, Bergh.

R. Bergh, Beitr. zur Kennt. der Aeolidiaden; Verh. der K. K. Zoölb. Ges. in Wien, xxiii. 1873, p. 619.

Hab. Oc. Atlant. septentr.

1. *Aeolidia papillosa* (L.).

Hab. Oc. Pacificum (Sanborn Harbor, Nagai, Shumagin Islands, Alaska Territory).

Only one specimen of this species was taken by Dall in July, 1872, in Sanborn Harbor (Shumagin Isl.) at low water on rocky bottom.

According to Dall the color of the living animal was yellowish-white; the color of the animal preserved *in spirits* was also uniformly yellowish-white. The length was about 15.0 mm., with a breadth of body of 9.0 and a height of 5.0 mm., the breadth of the foot 5.5, the length of the papillæ 4.5, the length of the rhinophoria and of the tentacles about 2.0 mm.

The form of the (rather contracted) animal was nearly that of the *Ae. papillosa*, in general and in most particulars; the papillæ were set in very many oblique rows, closely crowded.

The central nervous system showed the cerebro-visceral ganglia rather elongated, the pedal ones of rounded form, more than half as large as the former; the subcerebral, the pedal, and the visceral commissures as usual, the latter with the *N. genitalis*. The buccal ganglia elongate, of nearly semi-oval form, the commissure

¹ Alder and Hancock, Mon. Brit. Nud. Moll., Part VI., fam. 3, pl. 9, f. 6.

between them short, equalling about one-sixth of the longitudinal diameter of the ganglion; the gastro-œsophageal ganglia nearly one-sixth of the buccal ones in size, with one very large and two rather large cells, their stalk a little longer than the commissure between the buccal ganglia.

The *eye* has quite black pigment, and a yellowish lens. The otocyst is situated some distance behind the eye, and is filled with otoconia of the usual kind.

The *bulbus pharyngeus* is of the usual size, about 5.0 mm. long, 3.0 mm. broad, 3.5 mm. high; its form is as usual. The jaws exactly as in the typical *Ae. papillosa*. The radula contained thirteen teeth, beside seven mature and two immature teeth in the sheath, twenty-two altogether. The anterior plate was about 0.25 mm. broad, the posterior one about 0.75 mm.; yellowish horn colored; there were thirty-two denticles on the former and forty-two on the latter.

2. *Aeolidia papillosa*, var. *Pacifica*, Pl. I. f. 1-6.

Colore e flavido albescens.

Hab. Oc. Pacific septentr. (Chignik Bay, Aliaska Pen.).

Three specimens of this form were taken by Dall on mud flats at low water in Chignik Bay, Aliaska, July, 1874.

According to Dall the color of the living animal was pale yellowish-white.

The alcoholic specimens were all of nearly the same size, about 20.0 mm. long, 7-8.0 mm. broad, and 6-6.5 mm. high. The tentacles and rhinophoria measured about 2.0 mm. in length, the papillæ of the back reached 3.0 mm. in length, and the breadth of the foot 5.0 mm. The color was yellowish-white, the papillæ a little grayish, and generally with white points. The viscera were not visible through the side walls of the body.

The form of the animal was typical, somewhat depressed; the head rather large, the tentacles short and strong, stronger than the rhinophoria, the eyes not visible through the wall of the back. The foot was rather large, somewhat pointed behind, the anterior margin straight, with a very distinct transverse groove. The sides of the body rather elevated, with the genital papilla beneath the eighth and tenth row of papillæ. The back was naked in its broadest part; in the much narrower side parts covered with closely set oblique rows of papillæ, which, on the hindmost part,

cover the back entirely. The number of rows was about twenty-five to thirty-two, the foremost shorter, with about seven to nine papillæ; the hindmost the shortest, with about three to four papillæ, the rest longer and much more oblique, with about twelve to thirteen papillæ. The papillæ flattened, quite as in other true *Aeolidiæ*. The anus is between the outer part of two rows behind the middle of the back (at about the thirteenth or fifteenth row). The intestines were seen very distinctly shining through the wall of the back.

The cerebro-visceral ganglia were somewhat elongated, reniform, thinner and broader in the fore part, thicker in the hindmost part; the pedal ones rounded, triangular, as thick as the confining part of the visceral ganglia. The buccal ganglia were about one-quarter of the size of the pedal ones; the gastro-æsoophageal ganglia rounded, about one-quarter of the size of the buccal ones, with three large cells.

The eye was furnished with black pigment and yellow lens. The otoeysts could not be found.

The buccal tube short, rather wide, with strong longitudinal folds on the inside. The *bulbus pharyngeus* rather short, somewhat compressed; in length about 3.5 mm. by a height of 2.75, and a breadth of about 2.0 mm. The form-relations for the rest quite as in the *Aeolidia serotina* (cf. l. c.). The mandibles (fig. 1) were very strong, flattened, yellowish, or brownish-yellow; the articulation strongly developed, on the anterior outer side somewhat twisted, slightly bilobed; the keel on the inside (*crista connectiva*) short, somewhat prominent (fig. 1a); the cutting blades (*processus masticatorius*) rather prominent (fig. 1b), the margin with very fine longitudinal lines (fig. 2). The tongue rather short and strong (on the under side, the end, and the upper side), with 13 plates, under the narrow *tectum radulæ* and further backward in the sheath (*vagina, pulpa radulæ*) seven developed and two immature teeth; the total number of teeth was twenty-two. The plates similar in form (fig. 3, 4) to those of the two other species; light brown-yellowish; on each side of the nearly imperceptible median impression and prominence—in the foremost plates thirteen, in the hindmost as many as seventeen lancet-formed denticles; the breadth of the foremost teeth was about 0.3 mm.; of the hindmost nearly 0.68 mm.

The salivary glands were as in the typical form.

The œsophagus, the stomach, the biliary ducts, and the intestine, as in other species; the stomach on each side receiving a biliary duct, and the posterior chief duct receiving from each side three strong and one to two finer ducts; the length of the intestine was about 9.0 mm., with fine longitudinal folds along the inside. The liver papillæ (in the dorsal papillæ) rather nodose. The *bursa cnidophora* in the largest papillæ measured one-seventh to one-eighth of the length of the papilla, containing a mass of cnidæ, elongate-pyriform or staff-shaped, reaching 0.026 mm. in length (fig. 6).

The heart and renal syrx as usual.

The hermaphroditic gland is large and yellowish, of the usual structure; in the centre of the zoöspemic lobules were oögene cells in peripheral nodosities. The anterior genital mass short and clumsy, about 5 to 6.0 mm. long by 2.5 to 3.0 mm. broad, and 4 to 4.5 mm. high. The *gl. mucosa* and *albuminifera* white and whitish. The *vas deferens* (fig. 5a) yellowish, very long, rolled up in a tight coil on the fore end of the genital mass; the penis (retracted) short, bag-shaped, about 2 mm. long, nearly filled by the conical glans (fig. 5), through the whole length of which the continuation of the sperm duct could be traced.

There was a peculiar aspect in the interior of this *Aeolidia* (as well as in the *Ae. serotina*) as far as observations on alcoholic specimens go, which seemed to indicate a possible specific difference from the typical *Ae. papillosa*, although the anatomical examination could not bring out any very reliable specific characters.

II. CORYPHELLA, Gray.

Coryphella, Gray, Figures of Moll. Anim, iv. 1850, p. 109. Gray, Guide, i. 1857, p. 224. Alder and Hanc. Monogr., Part VII. 1855, p. 49; Appendix, p. xxii. R. Bergh, Anat. Bidr. til Kundsk. om Aeolid., l. c., 1864, p. 226. R. Bergh, Beitr. zur Kenntn. d. Aeolidiaden. iii., l. c. xxv. 1875, p. 633.

Corpus elongatum. Rhinophoria simplicia. Podarium antice angulatum vel angulis productis.

Processus masticatorius *mandibulæ* seriebus denticulorum præditus. Radula dentibus triseriatis; dentes laterales margine supero (interno) denticulati. Penis inermis.

The genus contains *Aeolidiidae* of an elongated form, with simple rhinophoria and with the anterior margin of the foot

angulated or with the angles rather produced. The edge of the cutting-blades of the mandibles with several rows of knobs or denticles. The lateral plates of the tongue have the superior (interior) margin not smooth (as in the *Galvinæ*) but denticulated. The penis is unarmed.

In my last memoir upon this genus, to which the reader is referred, I have given a list of nineteen species which seem to belong to this genus. Four of them are from the Pacific ocean.

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| 1. <i>C. Foulisi</i> (Angas). | 3. <i>C. parvula</i> (Angas). |
| 2. <i>C. semidecora</i> (Angas). | 4. <i>C. athadona</i> , Bergh. |

1. *Coryphella*, sp. Pl. I. f. 13-14; Pl. II. f. 7-8.

Hab. M. Pacif. (Ins. Aleut.).

Only the *bulbus pharyngeus* of this form has been found by Dall in dredging at Adakh Island (Aleutians) in mud, at a depth of 9-16 fathoms, in June, 1873.

The length of the organ was 5.0 mm., with a height of 4.0 and a breadth of 5.0 mm.; the form short, much broader in the hindmost part; the radula sheath a little prominent behind the buccal ganglia. The labial disk of usual oval form;¹ the greatest part of the *bulbus* covered by the mandibles; the *m. transv. sup* rather large. The mandibles (fig. 7) large, nearly as long and as high as the *bulbus*, of yellow horn-color; the articulation rather small (Fig. 7a); the edges of the cutting blades with 4 to 6 (fig. 8, 13) rows of low knobs, which on the anterior margin, except in the uppermost parts of the cutting blade, rise to denticles of the height of 0.1 mm. The *tongue* rather short; on the upper side nine rows of plates, further backwards seven rows of developed and two of not quite developed teeth; the total number of rows was eighteen. The teeth as usual of horn-yellow color, very strong; the breadth of the foremost medial ones about 0.16, of the hindmost 0.25 mm. The medial ones with five to seven denticles on each side of the strong point (fig. 14); the lateral ones with a long point, and five to six denticles on the inside at the base (fig. 14aa).

The cerebro-visceral ganglia short, reniform, somewhat broader at the anterior end; the pedal ganglia rounded, scarcely smaller than the former. The buccal ganglia are of oval form, about one-

¹ In the mouth, half hanging out, was found a fine *Caprella*, the body having the length of 6 mm.

third the size of the pedal ones, the commissure between them measuring about one-third the length of each ganglion.

III. FLABELLINA, Cuvier.

Flabellina, Cuvier, Règne An. ed. ii^a, 1830, iii. p. 55. Alder and Hancock, Mon., Part VII. p. xxi. 1855. Trinchese, Rendic. della Acad. della Sci. di Bologna, 7, 1874. R. Bergh, Beitr. zur Kenntn. d. Aeolidiaden, iii., Verh. d. K. K. Zool.-bot. Ges. in Wien, xxv. p. 647, 1875.

Corpus sat elongatum, subcompressum. Rhinophoria perfoliata. Papillæ (dorsales) non caducæ, pedamentis brachioformibus insertæ. Podarium angulis tentaculatim productis.

Margo masticatorius mandibulæ seriebus denticulorum præditus. *Radula* triseriata, dentibus medianis denticulati, lateralibus interno margine denticulatis. Penis stylo armatus.

As for the history of the denomination of this genus the reader must be referred to my above cited paper. The *Flabellinæ* have nearest relation to the *Calmæ*,¹ but differ by the perfoliate rhinophoria and in the denticulation of the lateral teeth. They show an elongate, somewhat compressed form of the body; perfoliated rhinophoria; dorsal papillæ caducous, inserted upon arm-shaped foot-stalks the foot with produced anterior angles. The cutting edges of the jaws with rows of small denticles. The tongue with three series of teeth; the median denticulated in the usual way, the lateral ones only on the inner edge. The penis with a stylus (as in the *Calmæ*).

To this genus belong:—

1. *F. affinis* (Gm.), Bergh, l. c. p. 649, Taf. XV. f. 6-19; Taf. XVI. f. 3-4. M. Medit.
2. *F. flabellina* (Ver.), M. Medit.
3. *F. ianthina*, Angas, M. Pacificum.
4. *F. ornata*, Angas, M. Pacificum.
5. *F. Newcombi*, Angas, M. Pacificum.
6. *F. iodinea* (Cooper), M. Pacific. orient.
1. *Flabellina iodinea* (Cooper), Plate I. f. 15 to 17; Plate II. f. 16.
Aeolis (*Phidiana*?) *iodinea*, Cooper, Proc. Calif. Acad. ii. 1862, p. 205; ² iii. 1863, p. 60.

¹ Cf. my above cited paper, l. c. p. 643.

² "Rich, violet purple, narrow, wedge-shaped, high in front, tapering to an acute point behind, slightly constricted in five parts of the body corresponding to divisions of the branchiæ. Foot very narrow, slightly expanded.

Phidiana iodinea, Cooper, Bergh, Beitr. zur Kenntn. d. Aeolidiaden, i., l. c. xxiii. p. 615,¹ 1873.

Color corporis e violaceo purpureus, rhinophoria aurantiaca, papillæ aurantiace-rubra (Cooper).

Dentes mediani sicut laterales, multidenticulati.

Hab. Ocean. pacific. orient. (San Diego, Cal. to Puget Sound.)

A single specimen was collected by Capt. Hall alive, on algæ, at low water in Puget Sound, Washington Territory, Aug. 1873. According to Cooper (l. c. p. 205) the species is found "among algæ, outside of San Diego Bay, rarely inside." According to Cooper's description and a drawing kindly lent by Dall, the color of the living animal is violet purple, the rhinophoria orange colored, the papillæ orange-red.

The length of the individual (most badly) conserved in spirits was about 15.0 mm., with a breadth of the body of 2.0, and a height of 2.5 mm.; the length of the papillæ reaching to about 4.0 mm.; the length of the tentacula about 1.5 of the rhinophoria, about 2.3 mm. The color rather dirty chocolate.

The *form* is elongated, rather compressed, the tail rather short. The head rather small, the tentacula elongate, also the apparently closely perfoliated rhinophoria. The back rather narrow; the groups of papillæ situated on the side parts of it, firmly affixed on the edge of foot-stalks, whose form and number could not be determined, owing to the state of the specimen; their number seemed to be much greater than referred to by Cooper. The foot rather narrow, the angles of the foremost margin much produced, longer than the tentacula, strong; the groove in the anterior margin continued along the angles.

The eyes are rather large, with black pigment.

The *jaws* more rounded at the posterior end than in the *Fl. affinis* (l. c. Pl. XV. f. 13), otherwise as in that species; the cutting edge with several rows of small rounded denticles (fig. 15). The state

Head obtuse, with four tentacles, the upper longer and turned upwards, the lower deflexed. Two club-shaped, orange-colored appendages a little behind the upper tentacles. Branchiæ short, in a double row, close together near the median line, their color orange-red. Length two and a half inches, breadth one-fifth of an inch." Cooper, l. c.

¹ The "descriptions" of Cooper are of the kind which have caused so much confusion in science, so light and trifling that there properly should no notice at all be taken of them.

of the specimen examined¹ did not permit the determination of the number of plates of the tongue and the posterior continuation of the radula. The *median plates* (Pl. II. fig. 16a) with a greater number of denticles, mostly with about 12-13; the lateral ones with a rather produced outer limb (fig. 16b, Pl. I. figs. 16, 17), the inner edge with a rather great number of (about 25-27) fine denticles.

As far as could be determined, a Penis-style existed, as it seemed, of about the same form as in *Fl. affinis* (cf. l. c. Pl. XVI. f. 3, 4).

IV. HERMISSENDA, Bgh.

Hermisenda, Bgh., Beitr. zur Kenntn. den Aeolidiaden, vi. ; Verh. d. K. K. Zool.-bot. Ges. in Wien. xxviii. 1878, p. 573.

Corpus gracilius elongatum. Rhinophoria perfoliata, tentacula elongata. Papillæ dorsales in series obliquas et transversas confertas areis præsertim compluribus collatas dispositæ. Podarium antice angulis elongatis.

Margo masticatorius *mandibulæ* singula serie denticulorum præditus. Radula dentibus uniseriatis, denticulis elongatis præditis et cuspidè infra serrulata. Penis inermis.

In many respects this new genus seems to agree with the *Phidianeæ*, as far as these are now known.² The general form of the body, the rhinophoria and the tentacula are as in that genus, also perhaps the disposition of the dorsal papillæ. But the *Hermisendæ* differ in the rather produced angles of the front of the foot, in the form of the teeth of the tongue, but especially in the want of a hook on the penis.

The body is rather elongated, slender. The rhinophoria are perfoliate, the tentacula long. The dorsal papillæ seems to be arranged in oblique and transverse rows, which form several more or less separated groups. The angles of the front of the foot are rather elongated.

The cutting edge of the jaws has a single row of strong pointed denticles. The teeth are in a single series; each tooth with five

¹ The individual seemed to have been found dry in the glass and put in new alcohol in such a state. Even the outer form could not be determined before the specimen was softened.

² R. Bergh, Neue Beitr. zur Kenntniss der Aeolidiaden, I. Verh. d. K. K. Zool.-bot. Ges. in Wien. xxiii. 1873, pp. 613-618.

denticulations on the under side of the trigonal point and long denticles of the cutting edge at the base of the point. The penis is unarmed.

Only one species of the group is hitherto known.

1. *Hermisenda opalescens* (Cooper). Plate I. fig. 9; Pl. II. f. 1-6.

Aeolis (*Flabellina*?) *opalescens*, Cooper, Proc. Cal. Acad. ii. 1862, p. 205,¹ iii. p. 60, 1863.

Hermisenda opalescens, Bergh, l. c.

Color corporis e caerulescente albens, pellucidus; rhinophoria opalina, nucha stria longitudinali aurantiaca; papillæ lutescentes, apice purpurascenti.

Hab. San Diego Bay, Cala. to Sitka, Alaska Territory.

Of this species Dall found two living specimens at Sitka, on algæ at a depth of 6-10 fathoms, Aug. 18th, 1865.

Cooper saw "this elegant species" numerous in the San Diego Bay in the winter, living among the (sea) grass and "depositing its ova on any fixed object it meets with."

According to Cooper's description and drawings kindly lent me by Dall the living animal is nearly transparent, bluish-white, the rhinophoria of opaline color, with an orange stripe between them; the papillæ of yellowish color with a purple or blood-red spot near the end. Dall regards the animals, found by him, as identical with the species of Cooper,² although the colors according to some (4) colored sketches of Dall are rather different from those mentioned by Cooper. For these sketches the color is grass-green, much paler on the under side (foot), the rhinophoria whitish, the liver-lobes purple-red shining through the papillæ,

¹ "Bluish-white, pellucid, somewhat quadrangular, posteriorly wedge-shaped ending in a sharp point. Foot anteriorly with two short spreading appendages, laterally thin and flattened. Head short, tentacles two, long, acute (the lower pair replaced by the appendages of the foot); two erect club-shaped appendages (dorsal tentacles) on the anterior part of the back, of an opaline color, with an orange stripe between them. Branchiæ in five pairs of fasciculi along the upper edges of the back, each bundle of about four rows, largest above, their color yellowish with a purple or blood-red spot near the end. A rosy tint often visible from the string of ova shining through the abdominal walls. Length one and a half inch, breadth one-quarter inch (Cooper).

² My specimens and drawings were examined by Dr. Cooper in 1866, who referred them to his species, the types of the latter being now lost or destroyed.—W. H. D.

on the lateral part of the back along the papillæ yellow vessels (hepatic ducts?) shining through the walls of the back. According to Cooper the *length* of the living animal reaches about one and a half inch. Dall's specimens were only about seven lines in length.

The length of the individuals preserved in spirits was about 12.5–13.0 mm. by a breadth of 4–4.5, and a height of 3–4.25 mm.; the length of the tentacula was about 2.5–3.0, of the rhinophoria 2.5 mm., that of the papillæ reaching 4.0 mm.; the breadth of the front part of the foot 4.0 mm.; the length of the produced angles about 2 mm. The color was uniformly brownish-white; the intestines nowhere shining through the skin.

The head is rather large, the tentacles long and strong, the oral aperture as usual; the rhinophoria are strong, the club with about twenty to twenty-five leaves. The back is rather broad; the papillæ set in transverse or oblique rows, that were crowded in about four groups. The *first* group of papillæ is the largest of all, compressed—horse-shoe shaped, with about five to seven oblique rows in the foremost and four to five in the hindmost limb; the number of papillæ in the rows seemed not to surpass ten or twelve. The *second* group had about six to seven oblique rows; the number of papillæ in the rows seemed not to exceed eight or nine. The space between the first and second groups was larger than that between the second and third, in the uppermost part of the latter space is the rather prominent, goblet-formed or more applanate anal papillæ; more forward and downward was the renal pore, which in one individual was rather prominent. The *third* group on one (right) side composed of several (five to seven), on the other of fewer (three to four) rows, but never very distinct from the *fourth* group, which had about ten to fourteen densely set rows, which by degrees decrease in size backwards and cover the whole of the rest of the side parts of the back; sometimes the rows of this fourth group stand in pairs; the innermost parts of the rows are separated by very narrow spaces.¹ The papillæ conical, somewhat contracted in the inferior parts. The sides not low; the genital papillæ in the usual

¹ The state of conservation of the individuals did not permit me to ascertain the relations of the groups and the rows with full certainty, so much the more as the greater part of the papillæ had dropped off.

place (under the region between the two extremities of the first group of papillæ), contracted. The foot is strong, broader than the back, the muzzle rather broad and produced into angles anteriorly; their length about one-third of the breadth of the foot; the groove of the anterior margin is continued along the margin of the angles, the tail measuring about a third of the whole length of the foot.

The cerebro-visceral ganglia are rather short, not much larger than the short pyriform pedal ganglia.

The buccal ganglia are rounded, connected by a commissure which is a little longer than the diameter of the ganglia. The gastro-oesophageal ganglia are not long-stalked and have about 0.18 of the size of the last mentioned, with one large and two rather large cells.

The eye has black pigment and yellowish lens. Immediately behind the eye is the otocyst, scarcely larger than the eye, with thirty-five to forty-five otoconia of the usual form. The rhinophoria are as in related forms of *Aeolidiidae*.

The bulbus pharyngeus is shaped as usual, and is from 2.75 mm. to 4.5 mm. in length. The jaws (fig. 9), as commonly among the *Phidianæ* are yellowish-horn colored. The articulation (fig. 9a) is rather small; the cutting blades arched (fig. 9b) their edges with a series of about fifty strong, sharp pointed denticles (fig. 10), the uppermost short (fig. 10a), by degrees increasing in size to about the length of 0.06 mm.; the hindmost are serrulate (fig. 10b) on the posterior margin. The accessory buccal cavity behind the articulation of the jaw rather large, and filled with indeterminate animal matter.

The radula is rather long and keel-shaped, the edge nearly covered with twelve to fifteen teeth; behind these are eight to eleven developed and two not quite developed; the total number about twenty-five. The color of the teeth horny-yellowish or more brownish; the height of the oldest about 0.09, of the youngest 0.16 mm.; the length of the basal part reaching 0.3 mm.; the form (fig. 11, one to four) nearly as in the *Coryphellæ*, but the denticles (four to six on each side) longer and more slender and (what hitherto scarcely has been observed in any form of the group of *Aeolidiidae*) the trigonal points of the teeth are finely denticulated on the under margin (fig. 11, one to four).

The oesophagus is short. The stomach has rather strong folds.

The intestines are rather short, with a strong longitudinal fold through its first half, with many fine longitudinal folds in the anal papillæ. In the digestive channel were stems of Hydroidæ and different forms of Diatomaceæ.

The liver papillæ have a rather smooth surface. The *bursæ cnidophoræ* rather short, pyriform, with masses of small cnidæ (fig. 12), partly of oval form and generally measuring in length about 0.013 mm., partly shorter, staff-shaped, and rarely surpassing the length of about 0.01–0.07 mm.

The hermaphroditic gland is very large, the lobes and lobules as usual; in the centre of the last were zoosperms; in the peripheric (fig. 5) acini (which in very different numbers cover the central part) were oögene cells. The anterior genital mass was large, 2.2 to 4 mm., with a breadth of 1.2 to 2.75, and a height of 1.2 to 3 mm.; the whole, in great part formed by the *gland. mucosa et albuminosa*.

The *Spermatotheca* seemed rather peculiar; it was sac-shaped, rather short, and short-stalked; the free end of the *vas deferens* was only two or three times as long as the penis, somewhat thicker in the middle, strong, continued (fig. 6a) through the whole length of the penis. The retracted *glans penis* in its sheath (fig. 6bb) which had a length of about 3.5 mm., as also the glans, which was strong, short, sausage-shaped, with a round opening at the end (fig. 6c). A layer of rather short sacculate glands filled the end of the penis around the orifice. One of the drawings represents the spawn of *Ae. opalescens* as a rather long corkscrew-shaped coil of reddish hue.

V. FIONA, Hanc. et Embleton.

Fiona, H. et E. Forbes and Hanley, Brit. Moll., iii. 1853, p. x. Ald. and Hanc., Monogr. Brit. Nudibr. Moll., Part VII., 1855, pp. 52, 53, fam. 3, Pl. 38a. R. Bergh, anatom. Unders. af *Fiona atlant.* Vdsk. Meddel. fra naturh. Foren, i Kjobenhavn for 1857, pp. 273–337 (279–283 !), 1858, Tab. II.–III. R. Bergh, Contrib. to a Monogr. of the Gen. *Fiona*, H., 2 w. pl. Copenhagen, 1859. R. Bergh, Journ. d. Mus. Godef. 2te Heft, 1873, pp. 80–88, Tab. XII. fig. 4, 5. R. Bergh, Beitr. zur Kenntn. der Aeolidiaden, I; Verh. d. K. K. Zoöl.-bot. Ges. in Wien, xxiii. 1873, pp. 605–610. V, l. c., xxvii. 1877, pp. 823–824.

Hymenaeolis, F. Costa, Annuario del Mus. zool. di Napoli, iii., 1866, pp. 64, 80; iv. 1867, p. 28.

Rhinophoria et tentacula subsimilia, simplicia. Papillæ (dorsales) cuti firmius affixæ, elongatæ, ab membranam branchialem

quasi alatae, bursa cnidophora nulla. Anus dorsualis dextrorsum, apertura genitalis gemina. *Mandibulæ* cymbiolatæ, processu masticatorio brevior subhamato, margine masticatorio sat grosse denticulato. Lingua elongata, compressa, serie dentium unica; dentes arcuati, cruribus angustis, acie cuspidè prominulo et utrinque denticularis compluribus.

For the general characters of the genus the reader is referred to my monograph (1857) and to the above cited publications (1873).

The animals are pelagic, but few species are yet known, which besides are not well distinguished, and may perhaps prove to belong to one circumæquatorial and cosmopolitan form.

They are:—

1. *F. marina* (Försk.) M. Atlant. mediterr.
2. *F. pinnata* (Eschsch.) M. Pacific. sept.
Bergh, l. c. xxiii. p. 606, 1873.
3. *F. longicauda* (Quoy and Gaim.) M. Pacificum.
4. *F. ? alba* (Van Hasselt) M. Indicum.

I. *Fiona marina* (Försk.), var. *pacifica* Bergh. Plate I. fig. 7-8.

Limax marina, Förskal.

Fiona nobilis, Hancock and Embleton, l. c.

Fiona atlantica, Bergh, l. c.

Hymenaeolis elegantissima, A. Costa, l. c.

Color caerulescente-purpureus (Dall).

Hab. Oc. Pacificum, Atlanticum, Mediterraneum.

A single individual of this species was taken by Dall in 1873, in the open sea five hundred miles west of San Francisco, California, feeding on *Velellæ*.

According to Dall the color of the living animal was blue purple (like *Janthina communis*; D.).

The individual, not too well preserved in spirits, was about 12.0 mm. long, 5.5 high, and 6.0 mm. wide in the broadest part. The front of the foot was 3.75 mm. broad, the tentacles 1.0 mm. long, the rhinophoria 1.25 mm., the papillæ of the back 2.5 mm. The color (in spirits) light yellowish-brown, the viscera indistinctly perceptible through the walls of the body.

The form of the body was rather stout;¹ the head flattened, rather broad, broader than tentacles,² which are pointed and some-

¹ Cf. l. c., 1858, Tab. I. f. 1.

² Cf. l. c., 1858, Tab. I. f. 1-2.

what flattened. The rhinophoria are smooth, scarcely longer than the tentacles. The eyes are not visible externally. The back throughout its whole length naked on the broader middle part; laterally closely set with oblique rows of papillæ,¹ about seven to eight in each row, fewer in the fore and hindmost rows; the papillæ conical, somewhat compressed, particularly in the inferior parts, with the usual gill-membrane along the inner edge.² The anus in the usual place. The sides of the body rather high, the genital openings quite contracted. The foot in the foremost part rather broad, anteriorly rounded; backwards gradually narrower, the margins projecting a little from the sides; the tail rather short (about 1.5 mm. long), merely projecting a little behind the body.

The *central nervous system* is of the usual form,³ rather flattened; the cerebro-visceral ganglia rounded, triangular, the pedal ones a little larger, of oval form, the buccal and gastro-oesophageal ganglia as usual.

The eye is as usual, with black pigment, and with a rather large lens. The otocysts could not be detected.

The oral tube (retracted) about 1.5 mm. long, rather wide. The oral glands⁴ long as usual, opening in the oral tube; whitish. The *bulbus pharyngeus* 3.0 mm. long, with a breadth of about 1.8 mm., as formerly described.⁵ The mandibles also quite as in the typical form.⁶ The tongue long and narrow, as in the last;⁷ on the under side twelve, on the end two, and on the upper side twelve teeth; also in the sheath of the radula eleven developed teeth, and two not fully developed plates; the number of teeth was consequently thirty-nine.⁸ The form of the teeth (fig. 7, 8) was as usual; on

¹ Cf. l. c., 1858, Tab. I. f. 1-3.

² Cf. l. c., 1858, Tab. I. fig. 4-5.

³ Cf. l. c., Tab. I. fig. 7.

⁴ These glands, which have been formerly described by me as salivary, cannot be so homologized, because their ducts do not pass over the commissures of the central nervous system. Glands of the same kind have been found in other forms of *Aeolidiidae*, in the genus *Aeolidiella*, Bgh. (Cf. my. Beitr. zur Kenntn. d. Mollusken des Sargassomeeres. Verh. d. k. k. Zool.-bot. Ges. in Wien, xxi. 1871, Taf. XIII. fig. 20b, and Beitr. zur Kenntn. d. Aeolidiaden, ii. l. c. xxiv. 1874, p. 399, Taf. VIII. fig. 11bb).

⁵ Cf. l. c., Tab. I. fig. 8.

⁶ Cf. l. c., Tab. I. fig. 9-13.

⁷ Cf. l. c., Tab. I. fig. 16-18.

⁸ Cf. l. c., Tab. I. fig. 23-28. The author found in twenty-two specimens of the *F. atlantica* thirty-eight to fifty teeth; the number of denticles was mostly six to eight, sometimes eleven to twelve, on each side; later (Beitr.

the cutting edge were on each side seven to nine denticles; on the foremost teeth often nine; the breadth of the foremost teeth was about 0.13, of the twelfth 0.18 mm., the width amounting to 0.37 mm. or less.

True salivary glands do not exist. The œsophagus, the stomach, the intestine and the hepatic system, as far as could be determined, were quite as in the typical form.¹

The vascular system and the renal organ are as formerly described by me.²

The hermaphroditic gland³ is quite as in the typical form, also the hermaphroditic duct with its ampulla, and the spermatoduct with its two parts, one thicker and brownish, the other thinner and whitish. So also is the long (about 7 mm.) whip-like penis, which is drawn back and bent up and down in the thinner sheath-like part. The latter showed rather strong, circular, muscular belts, and had a *M. retractoris* attached near the neck; the continuation of the spermatoduct could be followed through the whole length of the penis to its point. The *spermatotheca* forms a short bag about 1.-3.0 mm. long, filled with sperma. The anterior genital mass is rather compressed, and about 4.25 mm. in length.

DENDRONOTIDÆ.

The *Dendronotidæ* form, like the *Scyllæidæ* and *Bornellidæ*,⁴ in certain respects a connecting link between the large group of *Aeolidiidæ* and the still larger group of *Dorididæ*. In those families the liver forms, as in the *Dorididæ*, a large compact mass, but branches are given off from the same, that penetrate (as very much reduced hepatic lobules) the dorsal appendages, which in this way become homologous with the papillæ of the *Aeolidiidæ*. In most other respects these groups agree with the *Aeolidiidæ*, especially in the nature of the bulbus with its strongly developed mandibles, and in the presence of only one *spermatotheca*.

zur Kenntn. d. Moll. des Sargassomeeres, l. c., 1871, p. 1287), he saw thirty-seven to forty-two teeth (in two individuals) with six denticles.

¹ Cf. l. c., Tab. II. fig. 30.

² Cf. l. c., Tab. II. fig. 31-32.

³ Cf. l. c., Tab. II. fig. 34-35.

⁴ These two families have been examined by the author in his *Mal. Untersuch.*, Heft vii. 1874, pp. 287-308 (*Bornellidæ*), and Heft viii. 1875, pp. 315-343 (*Scyllæidæ*).

The *Dendronotidæ* differ externally very distinctly from the *Scyllæidæ* and *Bornellidæ*, especially in the form of the dorsal papillæ; in the anatomical relations of the form of the mandibulæ and by the character of the *gl. hermaphrodisiaca*, which is not (as in the *Dorididæ*) separate from, but connected with the liver.

Only two generic forms of the family have hitherto been known.

1. *Dendronotus*, A. and H.
2. *Campaspe*, Bgh. Naturhist. Tidssk., 3 R. J., 1863, pp. 471-478, Tab. XII. figs. 1-17.

DENDRONOTUS, A. and H.

The true *Dendronoti* differ from the *Campaspæ* by the much more composite form of the frontal appendices, of the appendices of the margin of the sheath of rhinophoria, and of the dorsal papillæ. The lateral teeth of the tongue of the former especially are longer than in the *Campaspæ*.

Only a few species of the genus are hitherto known.

1. *D. arborescens* (O. F. Müller). M. Atlant.
2. *D. luteolus*, Lafont, Act. Soc. Linn. de Bord. 28, 1872. M. Atlant.
3. *D. robustus*, Verrill, Amer. Journ. of Sci. and Arts, n. s. L., 1870, p. 405. M. Pacif.
4. *D. iris*, Cooper, Proc. of the Cal. Acad. of Sciences, ii. 1862, p. 59, 1863. M. Pacif.
5. *D. purpureus*, Bgh. n. sp. M. Pacif.

1. *Dendronotus purpureus*, Bergh, n. sp. Plate I. fig. 18-20; Plate III. fig. 7-12.

Color purpureus.

Dentes medianæ (linguales) minutissime serrulati altamen non usque ad apicem.

Hab. M. Beringianum (Port Möller, Aliaska Peninsula).

Only one specimen of this species was taken by Dall at Port Möller on the north shore of Aliaska Pen., in September, 1874, at a depth of seventeen fathoms, sand. He notes only that the animal when living had the "mantle purple."

The color of the alcoholic specimen, which was not in the best condition, was reddish-brown, the head and foot yellowish. The length of the (partly mutilated) animal was apparently about 20.0 mm. when perfect, with a height of the body of about 6.5 and a breadth of nearly 5.0 mm. The height of the dorsal papillæ reached 3.0 mm. the breadth of the foot 3.5 mm.

The form resembled that of the typical species, the veil had two median arbusculi, and on each side three lateral ones, the median little larger than the laterals; between the median a small, simple, rather prominent papilla. A similar papilla seemed to exist between the two lateral arbusculi. Under the veil, on the upper lips of the simple muzzle were a series of small, simple, truncate papillæ; the most lateral one larger (representing the tentacle??).¹ The sheath of the rhinophoria high; above this was the usual larger branched appendage, divided at the top into five nearly similar appendages; the club not large, with about twenty rather thin, and very broad leaves (on each side) mostly alternating in breadth.² The body of the typical form had the arborescent papillæ, as in the typical species; the two foremost pairs seemed more branched and more divaricate, between them (in the region of the heart) lower arborescent tufts.³ Between the first and second papillæ of the right side was the large truncate anal prominence,⁴ and at its root in front the very fine renal pore. The sides of the body were rather high; the genital opening in the usual place in front of the region of the first (dorsal) papilla, with two fine apertures. The foot was rather narrow, scarcely divided from the sides of the body; the front end rounded, a groove between this and the under part of the mantle.

The cerebro-visceral ganglia were nearly as figured by Alder and Hancock (l. c., fig. 9), the cerebral part a little larger than the visceral; the pedal ganglia more rounded, and the commissure between them longer. The olfactory ganglia in the root of the club of the rhinophoria were nearly spherical, rather large. The buccal ganglia were of oval form, the commissure between them

¹ This is very likely the slight tentacular prolongation mentioned by Alder and Hancock. Meyer and Moebius (Fauna der Kieler-Bucht. i., 1865, Taf. V. fig. 8) neither mention nor represent any tentacles.

² Alder and Hancock mention in the *D. arborescens* "five or six large plates and intermediate smaller ones." Meyer and Moebius (l. c., p. 43) indicate twelve leaves. The number is still greater, reaching up to about thirty.

³ The animal examined had been mutilated by an enemy, the intestines were all left intact, but the walls of the body failed from behind the second papilla.

⁴ Neither Alder and Hancock nor Meyer and Moebius mention the situation of the anus.

a little shorter than the longest diameter of the ganglia; the *ganglia gastro-œsophagalia* in size were about one-eighth of the last, rounded, with a very large cell and several smaller ones. The commissures, as in the *D. arborescens*.¹

The *eye* was as usual, the pigment black.² The *otocyst* of the diameter of about 0.1 mm., crowded with otoconia of very (from about 0.004–0.0255 mm.) varying size. The leaves of the club of the rhinophoria without spicula, and also the skin of the body, which is easily detached from the subcutaneous muscular layer; on the dorsal papillæ especially, were masses of small yellowish sac-shaped glands containing fatty matter. The anal tube was short and wide, with longitudinal folds; the *bulbus pharyngeus* formed as in the typical species, 5.0 mm. long, 3.0 high, and 3.0 mm. broad. The insertion of the œsophagus was before the middle of the upper side. The labial disk or ring strong, radiately furrowed, of deep brown color internally; this inner portion formed a narrow prehensile collar, composed of rather irregular closely and obliquely set erect (fig. 18–20) spines, somewhat like those of the labial plates in so many *Dorididæ*, of dirty light yellowish-brown color,³ and about 4. mm. in height.

The mandibles were yellowish-horn color, except that the articulation was very dark-brown; the form was exactly as in the typical⁴ and in the following species (cf. Pl. III. fig. 2–3).

The *processus masticatorius* was rather short (fig. 7a), with a single series of small denticles exactly as in the *D. arborescens* (Pl. II. fig. 13; Pl. IV. fig. 1); the cavities behind the articulation of the mandibles were rather large (Pl. III. fig. 3). The tongue exactly as in the typical and in the next species (cf. Pl. II. fig. 9, 10); the *tectum* (fig. 9a) *radulæ* much extended forwards, and the superior (fig. 10a) part of the rasp therefore very short; the

¹ The visceral commissure has not hitherto been seen even by Ihering (l. c., p. 176); it is the foremost of the commissures, rather thin, the *N. genitalis* very distinct.

² In the *Dendron. arborescens* the end of the *n. opticus* is sometimes black.

³ A similar somewhat broader collar was found in the larger specimens of *D. arborescens*, but whitish like the rest of the labial disk, the spines (Pl. IV. fig. 2) were in more numerous rows (they hardly exceeded twenty in *D. purpureus*), and were light yellowish and longer. In two smaller individuals no trace of the collar could be found.

⁴ Cf. my above cited paper, Tab. XII. fig. 28–30.

rasp-sheath very obliquely descending between the muscular masses of the tongue, and appearing on the lowest part of the back side of the *bulbus pharyngeus* (fig. 10c). The rachis (fig. 9b) with nineteen rows of teeth on the anterior margin, and with one on the superior; besides three loose median teeth laying in the pocket on the inferior end of the tongue; in the sheath twenty-two developed rows and two undeveloped, the total number of rows was thus forty-four. The color of the median teeth horn-yellow, that of the lateral much brighter yellowish; the breadth of the eldest median teeth about 0.16 mm., of the eighth about 0.18, and of the latest developed 0.20 mm. The form of the teeth exactly as in the *D. arborescens* (cf. Pl. II. fig. 14). The median ones (fig. 8-10) with a very fine denticulation on the margin, much finer than in the typical species, and not reaching so far (cf. Pl. II. fig. 14, and Pl. III. fig. 10) out toward the point. The lateral plates number also about fourteen, of typical form; the first sometimes with traces of a slight serrulation on the inside of the hook, the following mostly with about five to six (sometimes even seven to nine) sharp denticles on the outside (fig. 11); in the three to four (rarely five) external plates the free hook disappearing more and more together with the denticles; the outermost, or the two outermost, were very thin¹ (Pl. III. fig. 5). Variations in the form of the lateral teeth, and coalescence of two teeth were often observed, quite as in the typical species (cf. Pl. III. fig. 1a).

¹ According to Alder and Hancock (l. c.) the number of rows of teeth in the *D. arborescens* is about forty, with nine lateral teeth on each side. Meyer and Moebius mention (l. c. p. 44) a "Radula," with forty-four rows (by which is probably meant the total number of rows on the rhachis and in the sheath), and with ten lateral teeth, and the same number of lateral teeth has been indicated by Loven. In my former examination (of two individuals) I saw sixteen to twenty-two rows on the rhachis and twenty-five to twenty-seven in the sheath, or a total number of forty-one to forty-nine rows, with ten to thirteen lateral teeth. In my present examination of five specimens of *D. arborescens* (like the former, all from the Greenland coast at Jacobshavn, etc.) I find the number of rows on the rhachis varying in small individuals from thirteen to eighteen, and those in the sheath from sixteen to twenty-three, the total number thus varying between twenty-nine and forty-one; in three large individuals, having a length of 35.0 mm., the number was 13 + 20 (33), 16 + 20 (36), and 23 + 26 (49); the number of lateral teeth being eleven in the former and thirteen in the latter. In all specimens two or three median teeth were found loose at the under side of the root of the tongue.

The salivary glands were very long, accompanying the œsophagus (cf. Pl. III. fig. 12a) and extending further backwards; the duct was also rather long (fig. 12b).

The œsophagus, stomach, and intestine were as in the typical species. The liver, perhaps in consequence of occasional contraction of the animal, much thinner anteriorly, much thicker posteriorly, and of a more grayish color.

The heart was as usual. The renal syrinx nearly equalled the ventricle of the heart in size. The renal organ, as far as could be determined, was as in the *Æolidiidae*. The hermaphroditic gland almost as in the typical species¹ covering the back of the liver from the anterior end of this organ (or nearly reaching the anterior genital mass) to a point between the last pair of branches for the dorsal papillæ. The gland forms a rather thick layer, which is a little narrower than the liver, and fills the longitudinal median groove in the upper side of it. It is of a slate gray color, owing to the peculiar pigment of the single glands; is composed of a mass of rather large, rounded, isolated, but (from reciprocal pressure) often subangulated glands (cf. Pl. II. fig. 15).

Neither developed zoöspores nor large oögene cells were found in the glands of the individual examined. The anterior genital mass was whitish and yellowish: and, as far as could be determined, quite as in the *Dendr. arborescens*; a very large part of the whole mass was formed by the long penis, which still seemed somewhat shorter than it usually is² in the typical species (cf. Pl. IV. fig. 4).

This form might, perhaps, prove to be identical with the form of *Dendronotus* "with the tips of the branchial tufts white," fished by Couthouy (U. S. Explor. Exped. Moll., 1852, p. 311), in Puget Sound; or even to agree with the *D. iris* of Cooper (l. c.). Under the circumstances, the form described above must very likely be regarded as a new species, not even identical with the nearly red *Tritonia pulchella* of A. and H. (Ann. Mag. Nat. Hist. iv. 1842, p. 33), which, like all the forms of *D. arborescens* is still dotted with yellow (cf. A. and H., Monogr., Part I., 1845, fam. 3,

¹ The representation by Alder and Hancock (l. c., Pl. II. fig. 1j) is incorrect.

² The penis seems to vary a good deal in the *Dendron. arborescens*, or at least to be very contractile.

pl. 3). Besides the color the form clearly differs in the *very weak serrulation of the median teeth*.

Dendronotus Dalli, Bergh, n. sp. Plate I. f. 21; Pl. II. f. 9-12; Pl. III. fig. 2-6.

Animal?

Dentes mediani margine lævigato.

Hab. Fretum Beringianum.

In dredging on rocky bottom at a depth of thirty-five fathoms in the Arctic Ocean, Bering Strait, August, 1855, Dr. Wm. Stimpson obtained the *bulbus pharyngeus* of a mollusk, which proves to be a *Dendronotus*.

The size of the *bulbus* was uncommonly large, the length being about 10.5, the breadth 7.0, and the height about 6.0 mm. Its form and that of the mandibles (fig. 2-4) resembled that of the same parts in *D. arborescens* and *D. purpureus*, but of somewhat darker color, the edge of the cutting blade (fig. 2c, 3c, 4) differing a little from that of the other species, and the serrulation of the denticles being more distinct than in them. The tongue (Pl. II. fig. 9, 10) as in the other species. There were on the rhachis twenty-four rows of teeth, in the sheath twenty-five developed and two not quite developed rows, the total number of rows amounting to fifty-one. The median teeth were of very dark, nearly black-brown color, reaching a breadth of 0.3 mm., without any trace of serrulation of the margin (fig. 11, 12b). The lateral teeth (fig. 5) number fourteen, rarely fifteen, quite as in the other species, the four to five outermost also without denticulations (fig. 21a, fig. 5a).

The *bulbus* clearly belonged to a *Dendronotus* different from the two former species. The *Dendron. arborescens* has the cutting edge of the median teeth very distinctly serrulated, and to the very point of the teeth; this serrulation is much weaker in the *D. purpureus* and shorter, but it *disappears entirely* in the *D. Dalli*, which, moreover, is distinguished by a somewhat peculiar form of the cutting edge of the mandibles. As the length of the *bulbus pharyngeus* in specimens of *D. arborescens*, preserved in spirits, commonly is about one-tenth of the length of the whole body (cf. my former paper) the *D. Dalli* is likely to reach the very notable length of about 100.0 mm.

TRITONIIDÆ.

The genus *Tritonia* was established by Cuvier as early as 1798, but may have been at first¹ hardly separable from the forms subsequently named *Dendronotus*, A. and H.

Cuvier gave no type of the genus. Lamarck soon afterward (1801) adopted the name of Cuvier,² but used as example the *Doris clavigera* of Müller, which has since become the type of the genus *Triopa*. Thus the genus must really take date from the later anatomical publication of Cuvier in 1802.³ The genus is not properly characterized here, and contains the *D. clavigera* (= *Triopa*), the *D. cervina* (= *Dendronotus*), the *D. coronata* (= *Doto*), the *D. arborescens* (= *Dendronotus*), and the *D. frondosa* (= *Tritonia Hombergi*), besides a form which Cuvier regarded as probably new, the *Tritonia Hombergi*, which he seems to establish as the type of the genus, especially in the first edition of the *Règne Animal*,⁴ and this has since been regarded as the typical form by all later authors.

Except that some new species of the genus were described, nearly nothing since Cuvier was known of these animals until the anatomical examination of the *Trit. tethydea*, by Delle Chiaje, 1824,⁵ and especially until the excellent publications of Alder and Hancock in 1855.⁶

The genus has by different authors been classed with other genera in different ways; as a family *Tritoniaceæ* (Menke, Philippi, Forbes, and Lovén); *Tritoniæ* (Fér., Rang); *Tritoniadæ* (Johnston); *Tritonidæ* (d'Orb.); but all the arrangements have been quite unnatural. Alder and Hancock first (1855) formed a natural group of *Tritoniadæ*,⁷ only including the genus *Tritonia*, and this family was soon after (1857) adopted by Gray.⁸

¹ Tabl. Elém. an vi. (1798), p. 387. "Le nombre des tentacules qui entourent la bouche varie de deux à huit." Cuvier, l. c.

² Lamarck, Syst. des animaux sans vert. an ix. (1801), p. 65.

³ Cuvier, Mém. sur le genre *Tritonia*, Ann. du Museum, 1, 1802, pp. 480-496, Pl. XXXI.-XXXII.

⁴ Cuvier, Règne Animal, ii. p. 391, 1817.

⁵ Delle Chiaje, Mem. sulle storia degli an. s. vert. iv. 1829. Tav. lxii. ed. 2. V. p. 74.

⁶ Alder and Hanc., Monogr. of the Brit. Nudibr. Moll., Part VII. 1855. fam. 2, Pl. I.-II.

⁷ Alder and Hanc., l. c. Part VII. 1855, app. p. xx.

⁸ Gray's Guide, i. 1857, p. 218.

The characters of the family seem at present to be formulable in the following way:—

Corpus subquadrilaterale, subelongatum. *Velum frontale* sat magnum, integrum vel sub-bilobum, margine laciniis tentacularibus fimbriatum. *Rhinophoria* vagina tubulosa, erecta, margine revoluto retractilia; petiolo cylindrico; clavo culmine obtuso obliquo margine pennis bipinnatis instructo. *Branchiæ* numerosæ, subpedicellatæ, arbusculi-formes, inæquales, margine palliali prominulo serie simplici dispositæ. Anus lateralis.

Bulbus pharyngeus magnus. *Mandibulæ* fortes, plus minusve elongatæ, sat applanatæ. *Radula* lata, multiseriata. Series dentium multidentatae, dens medianus latus, depressus vel nonnihil elongatus, subpyramidalis; utrinque dens lateralis mediano subsimilis, sed magis elongatus; dentes exteriores hamiformes, margine lævi vel denticulato.

Hepar non ramificatum. Spermatotheca unica. Penis elongatus, inermis.

The body of the *Tritoniidæ* is rather stout and strong, somewhat elongated, subquadrilateral. A large frontal veil covers the head; it is simple or more or less bilobed, the margin with more or less numerous, rather short, digitations. The sheaths of the *rhinophoria* erect, tubulous, with revoluted margin; their stalks cylindrical, the club oblique above, with bipinnate plumes on the margin. The gills are rather numerous, unequal, subpetiolate arborescent, inserted one behind the other upon the somewhat prominent pallial margin. The anus is before the middle of the right side, the *bulbus pharyngeus* very large and strong. The mandibles are very strong, elongated, the anterior extremity (articulation) arched upwards. The interior cutting edge coarsely serrated. The radula broad, with many series of plates, the series with many plates. The rhachidian tooth broad or more elongate subpyramidal; with a somewhat similar, but more elongated, lateral on each side. The remaining laterals (uncini) hook-shaped, the hook with smooth or denticulated margin. The liver is as in the *Dorididæ*, quite without ramifications. As in the former groups a single *spermatotheca* (the spermatocysts¹ wanting). The penis elongate, somewhat flagelliform, unarmed.

The *Tritoniidæ* form a connecting link between the large group

¹ I have used this name for the secondary spermatotheca of the *Dorididæ*.

of *Nudibranchiata* with a ramified liver, and those with a simple liver embracing the *Dorididæ* and the *Porostomata*¹ (*Doriopsidæ*, *Phyllidiidæ*).

As in the *Dorididæ* there is only one *spermatheca*; but in the general form of the body, and in the nature of the pharyngeal bulbous they show more affinity to the *Porostomata*.

The family seems to include but one genus, the proper *Tritoniæ*; two other established genera, the *Candiella* of Gray (Fig. Moll. An. iv. 1850, p. 106), with *Tr. plebeia* as type, and the *Nemocephala* of A. Costa (Atti della R. Acad. delle Sci. di Napoli, iii. No. 19, 1869) with the new (?) species (*N. marmorata*, C.) as type—very likely merge in the typical genus, at least the characters given by these authors do not raise these forms to new generic rank.

The animals belonging to this group are all slow, sluggish, and voracious. The *spawn* of the northern European species has been made known by Dalzell, Alder, and Hancock; of the developmental history nothing is hitherto known.

This group seems not to belong to the tropical seas. A small series of species has been published from the eastern part of the Atlantic (while only one is yet known (?) from the western), from the Mediterranean, the Red Sea, and the northern part of the Pacific.

1. *Tritonia Hombergi*, Cuv. N. Atlant.
2. *Tr. rubra*, Leuck. Rupp. Atlas, 1828, p. 15, t. 4, fig. 1.
3. *Tr. elegans*, Sav. Égypte, xxii. Pl. II. fig. 1, 1827.
Tr. glauca, Leuck. Rupp. Atl., p. 16, t. 4, fig. 2, 1828. Mare Rubrum.
4. *Tr. cyanobranchiata*, Leuck. Rupp., l. c., p. 16, t. 4, fig. 3 a, b, Mare Rubrum.
5. *Tr. decaphylla*, Cantr. Bull. de l'Ac. des Sci. de Brux. 11, p. 384, 1835.
Tr. quadrilatera Schultz, Phil. En. Moll. Soc., i. p. 103, t. xix. fig. 2; ii. p. 76.
? *Tr. Blainvillea*, Risso, Eur. Mérid. iv. p. 35, 1826. Verany, Journ. de Conchyl. iv. p. 386, 1853² (unpublished).
? (Juven.) *Tr. gibbosa*, Risso, l. c. p. 35. Mare Mediteran.

¹ I have used this name for a group including the *Doriopsidæ* and *Phyllidiidæ*; cf. my Mal. Unters. x. 1876.

² The species is named, but not described. The cited book of Verany has never been published. Last year a young friend, M. Vayssière, of Marseilles got some specimens from the family and kindly sent me one. Cf. my Mal. Unters., xiii. 1878, p. 530.

6. *Tr. tethydea*, Delle Chiaje, Mem. iv. 1829, t. 2, fig. 20, Ed. 2, v. p. 74. Mare Mediterran.
7. *Tr. Costæ*, Verany, Catal. p. 23, t. ii. fig. 7, 8, 1846. Mare Mediterran.
8. *Tr. Meyeri*, Verany, Zool. des Alpes Marit. p. 871, 1862. Mare Mediterran.
9. *Tr. acuminata*, O. G. Costa, Statistica fis. ed econ. dell'isola di Capri, ii. 1, 1840, p. 1840, p. 69, Tav. V. fig. 1 a, b.¹ Mare Mediterran.
10. *Tr. tetraquetra* (Pallas). Mare Pacificum.
11. *Tr. Palmeri*, Cooper, Proc. Cal. Acad. Sci., ii. 1863, p. 207. Mare Pacificum (Cal.).
12. *Tr. Hawaiensis*, Pease, Proc. Zool. Soc., xviii. 1860, p. 33. Mare Pacificum.
13. *Tr. pallida*, Stimpson, Proc. Phil. Acad. Nat. Sci., vii. p. 388, 1856. Mare Capense.
14. *Tr. cucullata*, Gould, Expl. Exp. Shells, 1852, p. 308. Mare Atlant. occid. (Brasilia).
15. *Tr. plebeia*, Johnst. Mare Atlant.
16. *Tr. lineata*, Alder and Hancock. Mare Atlant.
17. *Tr. (Duvancelia) gracilis*, Risso, l. c. p. 38. Mare Mediterran.
18. *Tr. manicata*, Desh., Tr. de Conchyl. 1839-1853, expl. des pl. p. 59, pl. 93, fig. 2.
 ? *Nemocephala marmorata*, A. Costa, Illustr. di due generi di Moll. Nudibr., Atti. della R. Ac. Sci. di Napoli, iii. No. 19, 1869, Tav. —. fig. 6-8. Mare Mediterran.

I. *Tritonia tetraquetra* (Pallas), Pl. III. f. 13-16; Pl. IV. fig. 5-12; Pl. V. fig. 1-2.
Limax tetraquetra, Pallas, Nova Acta Petrop. ii. p. 237, 239, Tab. V. f. 22, 1788.

Doris tetraquetra, Gmelin, S. N. ed. xiii. t. 6, p. 3106, 1789.

Color animalis cinerascens.

Hab. M. Pacific. septentr. (Insulæ Kurilæ, Aleutianæ).

This species was detected by Pallas, and described (l. c.) among his "marina varia nova et rariora;" and immediately afterwards was inserted by Gmelin in his undigested genus *Doris*; it seems not to have been mentioned since that time, nor recognized by any of the different explorers of the Pacific.²

Pallas got the animal from the Kuril Islands, "where the inhabitants eat it, raw or cooked, and where it is known by the name of Tochni." He says nothing about the colors of the animal, only

¹ On account of the rarity of the work cited (kindly given to me by Prof. A. Costa, of Naples, the son of the author) this species has only been mentioned by Gray, Guide, i. p. 218.

² Cuvier (l. c. p. 4) mentions the possibility of this species of Pallas being a *Tritonia*.

remarking that they are found larger than the figure he gives, which has a length of seven to eight centimetres.

Of this curious form only one specimen was found by Dall at Unalashka, on a reef at low water (in April, 1872). The color of the *living animal* is noted as having been "ashy gray."

The color of the animal, *preserved in spirits*, was uniformly light gray-yellowish; on the pinnæ of the plumes of the rhinophoria, but especially on the envelope of the papillæ of the club of these, were remains of a silverish-white, which is also seen on the lobes of the anus and the renal orifice. The length of the body was about 75.0 by a breadth of 37.5, and a height of 26.0 mm. In general the form of the animal was somewhat as in the typical *Tritonia*, rather stout; the anterior part of the body hardly narrower than the median, the posterior somewhat constricted. The back was a little convex, sloping backwards, rather smooth or very minutely granulated, feeling a little rough to the touch; on the edge finely tuberculated.¹ The edge projecting about 6 mm.; thinner towards the border, which is finely and irregularly toothed, but showed (Pl. III. fig. 14) few traces of gills;² on the left side the margin is continued to the (left) rhinophorium, on the right it did not reach quite to the region of the genital openings; backwards it grew narrower and thinner, over the tail it was nearly 2 mm. broad. The *rhinophoria* are rather distant from each other, almost entirely as in the *Tr. Hombergi*; the apertures of the prominent sheaths oval, with a diameter of about 6 mm., with the border undulated, and involuted. The stalk of the club low; the club itself cylindrical, about 3.75–4.0 mm. high; the central part of the club much lower, oblique; in the periphery the club is divided in several (about ten) larger, commonly bi- or tripinnate plumes, which sometimes are again divided into a medial with a lateral one on each side; between these stand sometimes one or two smaller and single plumes; the foremost is the lowest; the hindmost of all the plumes is the largest, and the stem of this is produced in a thick papilla projecting over all the plumes; from

¹ Pallas mentions the back as more unequal ("grandinoso-inæqualæ").

² Very likely the gills were rubbed off; on the other hand, Pallas, too, does neither mention nor in his figure represent gills, he only says that the back side has "anguli carunculato hiulci." (The animal when fresh showed no traces of any gills to the casual observer, and had not been subjected to rough handling.—DALL.)

the base of this papilla three to five low septula diverge, divide and go to the base of the plumes and their broad rhachides.¹ The veil entire (not bilobed); with the upper border (about 8 mm.) and the corners (about 10 mm.) freely projecting (fig. 13); it is (36 mm.) broad and (16 mm.) high; on the front side regularly furrowed by fine reticulated lines, which produce the appearance of a serpent's skin (Pl. IV. fig. 5); the upper edge of the veil is smooth or showing only traces of dentition;² there is no trace of the grooved fold on each side at the base of the veil found in the *Tr. Hombergi*; the end of the muzzle beneath the middle of the veil is contracted. The sides of the body somewhat high and convex, a little lower in the anterior part; decreasing in height from the region of the anus backward. The upper genital opening was entirely filled by the flagelliform penis (Pl. III. f. 13d) which was about 20.0 mm. long, with a diameter at the base of 3.0, and at the tip of 0.5 mm. The larger mucous gland (fig. 13) was below this opening. Behind the middle of the body is the crateriform anal papilla projecting about 3 mm., in the orifice of which are strongly projecting folds (Pl. III. fig. 15a) before which is the renal opening also provided with internal folds (fig. 15b). The foot is as long as the back, rounded in front, with a marginal groove which extends beyond the region of the genital orifices; the foot projects laterally some 3-4.0 mm. from the body. The tail is short, hardly 3.0 mm. long.

The peritoneum is colorless, the viscera not in the best preservation in the specimen examined.

The central nervous system closely resembles that of the *Tritonia Hombergi*,³ the limits of the two compartments of the cerebro-visceral ganglia are more pronounced than in the *Tr. Hombergi*;

¹ The representation of the rhinophoria of *Trit. Hombergi*, by Alder and Hanc. (l. c. part vii. 1855, fam. 2, pl. 2, fig. 2) is too simple.

² Pallas mentions and represents the veil as "lacero-dentatum."

³ The representation given by Alder and Hancock, as well as that of Ihering (Vergl. Anat. der Nervens. und Phylog. d. Moll., p. 174, Taf. II. f. 6) are nearly correct, at least in the essential characters; the short commissure between the cerebro-visceral and the pedal ganglia is of course double, as seen by Ihering, and perhaps also represented by Alder and Hancock, on the left side; in the hinder part of the left visceral and pedal ganglion is a small ganglion communicating with the visceral one; the gastro-oesophageal ganglia are shorter-stalked than represented by A. and H.

the buccal ganglia (Pl. IV. fig. 6) are rather large, of oval outline; the gastro-œsophageal rather short-stalked, ovoid, with three large cells (fig. 6a).

The eyes are as usual.¹ The otocysts about 0.2 mm. in diameter contain about sixty round or oval *otoconia*, reaching from 0.025 mm. rarely to 0.04 mm. in diameter, many of them marked with a few fine concentric lines.² The skin is almost free from spiculæ, they are almost entirely absent from the interstitial connective tissue.

The oral tube is rather short, about 6.0 mm. long, wide, with the usual longitudinal folds. The *bulbus pharyngeus* is strong, about 16.0 mm. long by 14.0 mm. broad and high. The form is in general shorter and stouter than in the typical *Tritonia*. The "muscle-plate" on the front side as in *Tr. Hombergi*.³

The jaws (Pl. IV. fig. 7) shorter, broader, and higher than in the *Tr. Hombergi*; the length of the united jaws was 12, the

¹ The eyes in *Tr. Hombergi* show black pigment and a yellow lens, they are about 0.28 mm. in diameter. The *nervus opticus* is about four times as long as the cerebro-visceral ganglion, and issues from a small ganglion situated near the pedal ganglion, giving out a nerve before reaching the eye, and continued in a third nerve beyond the eye. Cf. Ihering, l. c. p. 174.

² Alder and Hancock did not discover the otocysts in *Tr. Hombergi*, nor did I, but they were seen by Ihering.

³ The *bulbus pharyngeus* of the *Tritoniæ* is, as also the tongue, very like that of the *Pleurophyllidia*, but somewhat more flattened (cf. my Bidrag til en Monographi af *Pleurophyllidiæ*, Naturh. Tidsskr. 3 R. iv. 1866, pp. 224-356). The lip disk at the bottom of the oral tube is as in those; also the thick muscular plate at the front of the jaws (cf. l. c. p. 229), and with the usual transverse groove. In two individuals of the *Tr. Hombergi* of the length of 7.5 and 5.5 cm., the *bulb. phar.* had the length of 20 to 23 mm., a breadth of 12 to 15 mm., and a height of 11.5 to 15.0 mm., or the length of the bulbus amounted to about one-third that of the body; on the surface of the bulbus were marked partitions nearly as in the *Pleurophyllidiæ*; the sheath of the radula on the hinder and upper end of the bulbus was distinct, but not prominent. The united jaws 23 to 24 mm. long, with a breadth of 12 to 16, and a height of 6 to 7 mm.; the breadth of the jaw alone behind the articulation about 2.5, on the broadest part 6.75 to 7.0 mm.; the free part of the *proc. masticator*. 1.5 to 2.0 mm. long; the articulation rather prominent in front; nearly the posterior half of the cutting edge is serrated, every denticle composed of several, more or less coalescent, conical points, elevated about 0.16 mm.; a deep furrow for muscular insertion nearly parallel with the cutting edge.

breadth 13 mm., and the height 5 mm.; the jaw alone had behind the articulation (fig. 7a) a breadth of 5.5 to 7.0 mm. in the hinder part;¹ the length of the (free part of the) *proc. masticatorius* (fig. 7b) 1.5 mm.; the articulation rather prominent in front; the cutting edge in the posterior part slightly undulated, but plain, under the microscope covered with many irregular series of irregular prismatic bodies (fig. 16) about 0.02 mm. high. The tongue is large, broad, and high; the radula narrower than in *Tr. Hombergi*, brownish-yellow, with nineteen series of teeth.² On the under side of the tongue, moreover, the marks of eight series of teeth remain, the teeth themselves having been dropped. There were under the *tectum radulæ* and in the sheath twenty-five fully developed series, and six which were yet only partly colored. The number of series in all fifty. The number of teeth was, in one of the foremost series of the radula, about two hundred and twenty-five (on each side), and the number seemed not to increase notably farther backwards. The *median* tooth is like a compressed pyramid, somewhat narrower in the hinder part (Pl. IV. fig. 8aa; Pl. V. figs. 1aa, 2a), with the upper part bent backwards (fig. 8); the posterior margin more or less rounded, the anterior margin (fig. 1aa) with a slight cleft, the continuation of which (fig. 2a) forms a groove on the anterior side of the pyramid. The first lateral tooth shaped nearly as the medial is, but (fig. 8bbcc, 1bb, 2) narrower and longer, the (fig. 8) upper part less prominent, less crooked, and commonly more rounded at the top (fig. 8). The *second* lateral tooth either nearly like the first (fig. 8d), or with a distinct beginning of the form (fig. 1e, 2), that reigns through the long series of external teeth (fig. 12); *all* these lateral teeth are high (fig. 9), compressed, crooked; the point rather blunt; the basal part of the teeth is continued in an uncolored

¹ The form of the mandibulæ is rather similar to the figure of Pallas (l. c. fig. 22A).

² In a very large individual of the *Tr. Hombergi* the (always large) radula contained forty-three series of teeth, behind which were forty-seven additional series, the total number of rows being ninety. In the forty-second row or series, on each side, were about two hundred and eleven teeth, in the fifty-second row two hundred and twenty-nine lateral teeth. According to Alder and Hancock (l. c. part vii. pl. 46, suppl.) the number of rows is eighty-four, and the number of lateral teeth two hundred and twenty-one.

(not thickened), flexible process (fig. 9). The one to two *outermost* teeth small and in form very variable (fig. 10aa, 11aa). The teeth (in their thickened parts) of yellowish color, somewhat darker and less clear than in the typical species. The length of the rachidian teeth in the hinder part of the tongue 0.2 mm.; the greatest height of the lateral teeth (in about the same region) 0.4 mm. Double plates (fig. 12) were present.

The *glandulæ salivales* were clay-yellowish, about 25.0 mm. long, rather flattened; about 10.0 mm. broad on the under side, separated by the œsophagus; on the upper side confluent in a large convex plate, about 25.0 mm. broad. The efferent ducts were short.

The œsophagus was about 38.0 mm. long, with a diameter of 11.0 mm., and rose from the foremost part of the *bulbus pharyngeus*; in the posterior half were rather strong longitudinal folds passing without distinct limits into the stomach. The latter formed a moderately sized sac at the anterior part of the liver; the under side was free, the upper decked by a flat lobe of the liver. The stomach was somewhat compressed; in antero-posterior direction about 9.0 mm. high; the *cardia* were wide with two biliary orifices in the posterior part; above, a rather narrow pylorus with very strong folds; the walls of the stomach are rather smooth. The intestine issues from the uppermost part of stomach, appearing on the surface of the liver at the left side of the heart, following the left margin of the liver forwards, lodged in a groove on the surface, but backward at the front and end of the liver, following the right side of that organ, somewhat descending, then ascending again and terminating at the anus. The anteriorly proceeding part of the intestine was about 25.0 mm. long, the rest was about 50.0 mm. long, of which 15.0 mm. belonged to the part which ascends to the anus. The diameter of the terminal portions of the intestine was about 3.0 mm., of the middle portion nearly 7.0 mm. Through nearly the whole length of the intestine, and nearly reaching to the knee of the last ascending part, was a strong and thick fold of about 3 mm. in height; the last part of the same for a length of full 4 mm., free and projecting wing-like. Fine longitudinal folds, often shining through the walls of the intestine, were moreover seen through the whole length of it, in the first part especially strong on the under side; in the last part finer, partly ending in the folds of

the anal opening (Pl. III. fig. 65a). The contents of the intestine, stomach, and œsophagus were indistinct animal matter.

The liver of a clay-yellowish color, large; the length about 4.7 mm., with a breadth of 30, and a height of about 26.0 mm.; the hinder end rounded; the foremost half of the lower lobe wanting, its place occupied by the stomach; the front, therefore, very oblique, sloping backwards and somewhat towards the right side (with an impression for the large anterior genital mass). On the surface of the liver rather superficial furrows in different directions, especially transverse; through the middle part of the upper side of the liver, beginning at the right side, a somewhat deeper longitudinal furrow diverges towards the left side, containing the renal chamber; at the junction of the first and the second third of the upper side a very deep transverse groove for the pyloric part of the intestine (which turns to the left); but the part of the liver before the groove is a continuation of the whole liver, and not only of the left part of it (as in the *Tr. Hombergi*). The structure of the liver is as in the typical form.

The atrium and ventricle of the heart are as usual, the ventricle 9.0 mm. long, and the renal syrx about 3.0 mm. long, of the usual structure; the renal chamber, as far as it could be determined, as in the *Tr. Hombergi*.¹

The *gland. hermaphrodisiaca* not distinguishable in color from the liver, covering the surface of that organ nearly as in the *Tr. Hombergi*, and of similar structure. The follicles contained zoöperms and large oögene cells.

The anterior genital mass very large, 30.0 mm. long, 18.0 mm. in greatest breadth, and 23.0 mm. in greatest height. The *ductus hermaphrodisiacus* issues from the upper part of the front of the liver about in the middle line under the first reflection of the intestine. It is yellowish, not long, and about 1.0 mm. in diameter.

It swells rather abruptly into the ampulla, which is very long and strong, and forms a bunch of thick coils on the back of the anterior genital mass. When straightened the ampulla was about 120.0 mm. long; diameter variable, but reaching 6.0 mm. It was crammed with zoöperms. The spermato-duct (*vas deferens*) was strong, not long; furnished before entering the penis (in the specimen examined), with an ampulliform dilatation; then penetrating

¹ Cf. A. Hancock on the structure and homologies of the renal organ in the Nudibr. Moll. Trans. Linn. Soc., xxiv. p. 515, Pl. LIV. fig. 5-8, 1864.

the whole length of the everted penis, with several irregular dilations and constrictions through the posterior part, and ending on the blunted point of that organ with a small round orifice. The spermatoduct is attached to the walls of the penis by abundant connective tissue; its wall is very thick; the inside in the posterior part with some strong longitudinal folds, clothed with a fine epithelium, which towards the end of the penis is about 0.07 mm. in thickness. The (Pl. III. fig. 13*d*) penis, as above stated, flagelliform, about 20.0 mm. long, under the loop furnished with a whitish covering, partly confluent, partly scattered; in the skin through the whole length of the organ an infinity of bottle-shaped, glistening glands about 0.035 to 0.04 mm. in length. The *spermatotheca* pyriform, about 9 mm. long, passing without precise limit into a short ductus, that is a little dilated in the inferior part (vagina). The large mucous gland convex in front; on the back rather flat toward the anterior part, in the posterior excavated (for the reception of the ampulla of the hermaphroditic duct); the duct short; the cavity of the organ narrow, empty.¹

DORIDIDÆ.

This large group is easily distinguished through the (retractile or not retractile) branchial rosette on the middle of the back. This character is only found in a single other group of gastropoda, the *Doriopsidæ*, which, in their exterior characters, closely simulate the *Dorididæ*, and had been confounded with them, at least so far that they were regarded as both belonging to a single large group, until my examination of them² showed their affinity to the *Phyllidiidæ*,³ with which they were combined by me in a larger group, the *Porostomata*, particularly characterized through their poriform "outer mouth," and the conversion of the *bulbus pharyngeus* into a quite unarmed sucking apparatus. On the contrary the *Dorididæ* all show a very well-developed *bulbus*, with a more or less strong tongue; and often also a particular armature of the lip-disk on the anterior end of the *bulbus*, and

¹ Pallas (l. c. p. 238, fig. 22*B) seems to have seen different parts of the anterior genital mass.

² R. Bergh, neue Nacktschnecken der Sudsee. Journ. der Mus. Godeffroy. Heft viii. 1875, pp. 82-94, Taf. x. xi.

³ R. Bergh, Beitr. til Kundsk. om Phyllidierne (Schiödte) Natur. Tidsskr., 3 R. v. 1869, pp. 357-543, tab. xiv.-xxiv.

lip-plates of rather different kind and nature. With the *Doriopsideæ* (*Porostomata*) the *Dorididæ* agree in the presence of *two spermatothecæ*, and of a vascular gland connected with the central nervous system.

There have been detected but a small number of the generic forms and species belonging to this large family during Dall's expeditions.

ARCHIDORIS, Bergh.

Doris auct.

Archidoris, Bergh, Malac. Unters. (Semper, Philipp. ii. Heft xiv. p. 616, 1878).

Corpus sat molle subdepressum. Tentacula humilia, plicæ-formia intus altiora. Dorsum tuberculosum et granuloseum. Branchia (retractilis) e foliis tripinnatis formata. Podarium sat latum, margine anteriore superficialiter sulcatum.

Armatura labialis nulla. Radula rhachide nuda, plenris multidentates; dentes hamati. Ventriculus liber. Penis inermis.

When Linné, in the tenth edition of his *Systema Naturæ* (1758), founded the genus *Doris*, he referred but one species to it (cf. my Mal. Unters. [in Semper, Reise Philipp. II. ii.], Heft x. 1876, p. 388), his *D. verrucosa*. This, which was founded only on the figures of Seba and Rumphius, is probably indeterminable, and the *Doris* of the tenth edition of the Syst. Nat. should, therefore, not have been retained.

In the twelfth edition (1767) the genus embraces, beside *D. verrucosa*, which still figures as first species, three other forms, the *D. bilamellata*, *D. lævis*, and *D. argo*.

One of these should become the type of the restricted genus *Doris*, but which? It would be much better to quite do away with the name *Doris* as a generic designation (especially as it was also used in another sense by Linné, for the animal of various shell-bearing mollusks), and under this view the genus *Archidoris* has been formed.

This generic group, which is congeneric with the first of the sections established by Alder and Hancock (Monogr. part vii. 1855, p. xvi.) in their systematic prospectus, is rather distinctly marked. The animals are of a rather hard consistency, of a robust, and not much depressed form. The tentacles are formed in folds higher inwards. The openings of the *rhinophoria* are simple. The back more or less granulous and tuberculous. The (retractile)

gill composed of (a not large number of) tripinnate leaves. The lip-disk clothed with a simple thick cuticula. The radula with naked rhachis, the pleuræ with numerous hook-shaped uncini. The ventricle is large, free. The penis unarmed.

The group, so far as yet known, contains but few species.

1. *A. tuberculata* (Cuv.).
2. *A. flammea* (A. et H.).
3. *A. montereyensis* (Cooper).

Archidoris Montereyensis (Cooper), Plate XVI. figs. 6, 7.

Doris Montereyensis, Cooper, on new or rare Moll. inh. the coast of Cal.; Proc. Cal. Acad. Sci., ii. p. 204, 1863; iii. 1868, p. 58.¹

Archidoris Montereyensis. Bergh, l. c. p. 624, Taf LXVIII. fig. 24.

Color luteus vel ochraceus, supra maculis nigris sparsis et seriatis notatus.

Hab. Mare Pacificum. (Monterey, Cala. to Sitka, Alaska.)

Four specimens of this form were collected by Bischoff at low water in Sitka Harbor. Two were small and two much larger, but otherwise similar in every respect. No notes have been received in regard to the living animal. The specimens were sent me in a dried condition. They were of a yellowish or ochraceous yellow color with a larger or smaller number of roundish black spots on the back, here and there confluent in irregular large patches on the middle of the back, which were nevertheless indistinctly arranged in two series. The specimens measured 18.0–40.0 mm. in length, 11–24.0 mm. in breadth, and 5–13.0 mm. high. The width of the rhinophoral orifices in the largest specimen 4.9, and of the branchial aperture 10.0 mm. The back was covered, quite as in the typical species, with large and small rounded tubercles, reaching 1.5 mm. in diameter in the largest individual. The foot was large, exactly as in the typical species; the tentacles, as far as could be determined, of the usual kind.

In two of the individuals the gill was expanded, and the number of the branchial leaves 80.

Through the kindness of Mr. Dall I have had the opportunity

¹ "Pale yellowish, with scattered black spots (or entirely brown?); mantle rough, tuberculate, or nearly smooth; dorsal tentacles knob-shaped; branchial rays bipinnate, short, in eight divisions, forming a crown-shaped expansion on the posterior third of the dorsum. Foot expanded into a broad, thin margin as wide as the mantle. Length 3'', breadth 1'', height $\frac{3}{4}$ ''; form elongated oval." Cooper, l. c.

of examining a colored drawing of the animal made by Cooper. The color of the back was here ochre-yellow, with scattered small and some larger black spots; on the middle of the back especially several larger elongate irregular patches; the rhinophoria of somewhat more reddish color. In the gill eight leaves.

Through cautious emolition of one of the larger and one of the smaller individuals the nature of the *lip-disk* and of the armature of the tongue could be determined. The former was quite as in the typical species. The *tongue* showed thirteen to fifteen rows of plates; the number of rows further backward could not be determined with certainty, there seemed to be about fourteen to fifteen developed rows, and the total number of plates thus seemed scarcely to exceed thirty-three to thirty-six. The series seemed to contain about sixty to seventy plates. These plates (figs. 6, 7) were very like those of the typical species, perhaps the hook was a little slenderer; the height of the outermost plates (fig. 7) was commonly about 0.1–0.15, and the height increased through the series of plates to about 0.28 mm.

Perhaps this form might prove to be merely a variety of the *D. tuberculata*.

CHROMODORIS, Alder and Hancock.

Chromodoris, A. and H. Mon. Brit. Nudibr. Moll., vii. p. xviii. 1855. R. Bergh, Neue Nacktschn. der Sudsee ii. in Journ. der Mus. Godeffroy, Heft viii. pp. 72–82, 1875, and iv. l. c. Heft xiv. pp. 1–21, 1878.

Goniobranchus, Pease, Am. Journ. Conch. ii. 1866, p. 204.

Doriprismatica, A. d'Orbigny (pp.), Moll. des Isles Canaries, 1834, p. 40, note.

The *Chromodoridæ* of Alder and Hancock, the *Goniobranchi* of Pease were some years ago (1875) revised by me after careful examination of fourteen species, three of which were then published, the rest more recently (1878).

Meanwhile I had shown¹ that the genera *Glossodoris*, *Actinodoris*, and *Pterodoris*, established by Ehrenberg in 1831, should be dropped, being founded on non-essential and inconstant characters of the branchial leaflets of different *Chromodorides*. Moreover a part of the genus *Doriprismatica*, established by D'Orbigny (1834) belongs to this group. The name given by Alder and Hancock must be conserved for this genus.

¹ R. Bergh, Krit. Unt. der Ehrenberg'schen Doriden, Jahrb. d. D. Malak. Ges. iv. 1877, pp. 52–58.

In the latest of my cited papers was moreover given a supplement to the former list of described or denominated *Dorides*, that could be referred with more or less probability to this group. The number of species amounted to about ninety.

In external form the *Chromodorides* somewhat agree with the *Goniodorides*, but have much more gay and handsome colors, mostly forming longitudinal stripes. The tentacles are small, conical; the (retractile) rhinophoria with densely perfoliated club. The margin of the mantle on the anterior and posterior ends developed in a frontal and a caudal veil, which sometimes shows peculiar knots.¹ The (retractile) gill is formed of simply pinnate plumes, sometimes divided at the top. The foot rather narrow. The *lip-disk*, with an annular hard lamina, composed of densely set small hooks, mostly bifurcated at the top. In the radula no median plates, but often on the rhachis peculiar thickenings (pseudo-plates). The lateral plates, of ordinary form, nearly always serrulated or denticulated on the margin of the hook. The penis unarmed.

In the southern part of the Pacific the *Chromodorides* are represented by a whole series of species; from the northern part (China) only a few representatives are known; among the specimens sent by Dall only two species were detected, the hitherto known most northern representatives of this group, of which no form has yet been found in the northern part of the Atlantic.

Chromodoris Dalli, Bergh, n. sp., Plate XIII. f. 1-7; Plate XIV. f. 1-4.

Hab. Oc. Pacific. sept. (Puget Sound, Washington Territory.)

An individual of this species was obtained, during the progress of the U. S. Boundary Commission, by Dr. Kennerly, the lamented naturalist of the U. S. party, in Puget Sound. No notes have come to hand in regard to the living animal.

The animal preserved in spirits was 11.5 mm. long, 5.5 broad, and 4.2 mm. high. The height of the rhinophoria was 1.25 mm., of the tentacula 0.75 mm., of the branchial leaves 2.0 mm.; the breadth of the mantle margin 1.2 mm., of the foot 2.5 mm., and the length of the tail was 2.5 mm. The ground-color of the back and sides isabelline-gray, everywhere covered with small, and still smaller, coal-black, rounded points about 0.25 mm. in dia-

¹ Such knots have been found (by me) in the *Chr. runcinata*, *picturata*, *camæna*, *elegans*, *glauca*, *gonatophora*, and *Californiensis*.

meter, which were also visible on the under side of the mantle edge and on the upper side of the foot. The sides were also abundantly furnished with bright yellow points, appearing in smaller number also on the back where they are, for the most part, represented by yellow ocelli with darker yellow pupils. The mantle-edge had a yellow margin on the upper side; there was also a fine yellow line along the upper side of the edge of the foot. The stalk of the rhinophoria was gray, the club (grayish) reddish. The branchiæ and tentacula grayish-white with a yellow colored rhachis on the outer and posterior edge.

The branchial leaves with a few scattered black points, the margin of the orifice for the rhinophoria and of the gill cavity embellished with a yellow line.

The form as usual; the mantle edge rather prominent, the frontal and caudal veil not particularly developed (without traces of larger nodules on the under side). The club of the *rhinophoria* strong, with about thirty broad leaves; the tentacles conical (as it seemed), retractile in a little cavity. The *gill* consisting of fifteen (Pl. XIII. fig. 1) simple plumes; increasing four times in height from the posterior involute end gradually forward. The angles of the anterior margins of the foot not very prominent.

The intestines not shining through the walls of the body; the peritoneum colorless.

The central nervous system yellow. The *cerebro-visceral ganglia* reniform, the two divisions of nearly equal size; the rounded *pedal ganglia* a little larger than each of them; the great commissure not short. The proximal *olfactory ganglia* of about the same size as the distal (at the root of the club of the rhinophorium), larger than the optic ganglion. The *buccal ganglia* (Pl. XIV. fig. 1a) larger than the *olfactory*, of oval form, connected by a rather short commissure; the *gastro-oesophageal* (Pl. XIV. fig. 1b) rather short stalked, developed on one side of the nerve, small—about one-eighth the size of the former, with one large and some smaller cells. The *nervi optici* rather short. The eye with black pigment and a yellow lens. The otocysts of about the same size as the eyes, the number of otoconia not very large. The leaflets of the rhinophoria and the tentacula without spiculæ, the skin of the back and the interstitial tissue nearly so.

The oral tube very large, about 2.0 mm. long by 2.2 mm. in diameter, with strong, internal, longitudinal folds.

The *bulbus pharyngeus* 2.5 mm. long by 2.0 mm. broad and high. The radula reddish-gray, freely projecting about 2.5 mm. The armature of the lip-disk broad, rather thick, fine horny-yellow, consisting (Pl. XIII. fig. 2) of rather long (0.06 mm.) hooks, somewhat curved at their upper ends and slightly bifurcated at the point (fig. 3).

The tongue as usual, with about forty rows of teeth, behind which were sixty-six rows of developed, and six rows of immature teeth, the total number being one hundred and twelve. The teeth of yellowish color, except the rhachidian and external uncini, which were nearly colorless. The height of the second lateral (Pl. XIV. fig. 2) about 0.035 mm., of the most elevated teeth about 0.05 mm., of the outermost uncini 0.025 to 0.03 mm. On the narrow rhachis was a median pseudo-plate (rhachidian boss) about 0.035 mm. long, pointed anteriorly (Pl. XIII. fig. 4; Pl. XIV. fig. 1a) broader and rounded behind (Pl. XIII. fig. 5) consisting of a high anterior portion which falls abruptly toward the plain part, slopes gradually towards the fore-end, and is divided by a longitudinal groove into two halves (figs. 4, 5). On each side of the median plate twenty-seven to twenty-nine laterals. The lateral teeth of usual form, somewhat low; the (Pl. XIV. fig. 2) first with four to five denticulations on each side of the low hook; the rest (figs. 6, 7, 8) with such only on the outer side, mostly with six to seven, more rarely (especially on the inmost plates) with four to five, or at the utmost with eight to nine denticles; the six outermost of the usual aberrant form, without denticulations (Pl. XIV. fig. 3).

The *salivary glands* long, ribband-shaped, whitish. The *œsophagus* as usual; the intestine filled with large pieces of a *Ceratospongia*, mixed with some fragments of the lip-plates and some teeth from the radula. The *liver* about 6.0 mm. long by 3.0 mm. broad and high, truncate at the fore-end, rounded behind; the substance yellow.

The *renal layer* rather thick. The *sanguineous gland* whitish.

In the cavities of the *hermaphroditic gland* were zoöspirms. The *anterior genital mass* about 3.5 mm. long by a height of 3.0 and a breadth of 2.0 mm. The *ampulla* of the hermaphroditic duct rather (about 2.5 mm.) long, yellow. The *spermatoduct* very long; the first, darker, part forming a large flattened coil, the second passing into the short *penis*. The spherical *spermatheca*

(Pl. XIV fig. 4a) of a diameter of about 1 mm.; the longer *spermatocysta* forming a long *cul-de-sac* (fig. 4b). The *mucous gland* whitish, in the neighborhood of the anterior end was a yolk-yellow part.

2. *Chromodoris Californiensis*, Bergh, n. sp. Pl. XII. fig. 5 to 15.

Color caerulescens, dorso et lateribus punctus majoribus aureis ornatus.

Hab. Oc. Pacific. septentr. (coast of California, Santa Barbara Islands).

Of this very handsome species Dall obtained an individual on algæ at low water in the harbor of Catalina Island, California, January, 1874. (Specimens have also been seen from Monterey and San Diego.—W. H. D.)

The color of the living animal, according to Dall, was "mazarin-blue with golden spots" (changing to greenish-blue in the alcohol, which it continues to color for a long time, and after several changes for fresh spirit.—W. H. D.).

The rather contracted animal in spirits was 12.0 mm. long, and 6.0 mm. broad and high. The height of the retracted rhinophoria was 1.3 mm., of the retracted branchial plumes 1.5 mm., the length of the tail about 2.5 mm., and the breadth of the foot 2.0 mm.

The color was uniformly greenish-blue (which it had also given out to the alcohol). On the back were several yellowish-white, round spots, a millimetre in diameter. On the anterior part they were chiefly in the median line, on the rest in two longitudinal series, outside of which on the back were scattered some similar spots and on each side of the body was a line of four or five more of the same kind. A brighter, fine line seemed to border the margin of the mantle-edge and that of the foot. The rhinophoria were green-blue, the gills dark green-blue; the internal connecting branchial "mesenterium" and the root of the branchial leaves partly silver-white.

The *form* as usual. The mantle-edge little prominent except over the head and tail, the breadth on this last part being about 1.65 mm.; on the under side of the caudal veil thus formed were six semi-globular nodules (fig. 5) one full mm. in diameter. The tentacles as usual; the club of the rhinophoria with about twenty leaves. The gills formed of nine leaves of nearly equal size; the anal papilla rather low; posteriorly completing the branchial ring. The peritoneum with a light-bluish hue. The pericardium bluish.

The central nervous system as usual, but less depressed, and of greenish color; the cerebro-visceral ganglia reniform, somewhat broader in front; the distinction between the *cerebral* and the *visceral* parts very pronounced, the latter a little smaller than the former; the pedal ganglia rounded, a little larger than the visceral. The buccal ganglia larger than the (proximal) olfactory, roundish, connected by a rather short commissure; the gastro-œsophageal roundish, having about one-tenth of the size of the former, rather short-stalked, developed on one side of the nerve, with one very large and a few smaller cells. The proximal olfactory ganglia rather depressed—bulbiform; the distal ones much smaller, of oval form.

The lens of the eye was greenish-blue, the pigment brownish-black; the retina bluish. The otocysts were as usual. There were no spiculæ in the skin, the leaves of the rhinophoria or the interstitial tissue, which was always of a greenish-blue color. The nodules of the caudal veil resembled those of other species possessing them.

The oral tube was about 2.5 mm. long, and 1.6 mm. in diameter at the posterior end; of greenish-blue color throughout. The *bulbus pharyngeus* of the same or a darker shade, about 3.0 mm. long, by a breadth of 2.5 mm., and a height of nearly 2.0 mm.

The large sheath of the radula prominent posteriorly is also about 1.0 mm. in diameter. The lip-plates are of a grayish olive-green color, separated at their upper (fig. 6) and more widely at their lower ends. The plates are scarcely narrower above, the nearly uniform breadth being 1.5 mm. The elements of the plates reach the length of 0.045 mm., with thick, recurved, hooked points (figs. 7–10), these last were seldom cleft (fig. 10). The elements adjacent to the spaces between the plates were much smaller and of irregular form (fig. 6). The tongue was of the usual form, the radula shining like silver and grayish-green in color. In the radula were thirty-five rows of plates, behind which were fifty-one well-formed and six immature rows; the total amounting to eighty-two rows. In the posterior rows of the tongue were ninety-eight teeth on each side of the narrow and naked rhachis. The teeth had a very pronounced greenish hue; rising to the height of about 0.1 mm., that of the outermost was about 0.04 to 0.06 mm. The form as usual; the hook bifurcated at the point, the outer and posterior branch shorter, denticulated (figs. 11–13), and the den-

ticulations continued downwards along the exterior margin of the hook (fig. 13). The innermost teeth (fig. 11) lower and with fewer denticles; the largest number of teeth generally with about six to eight denticles; the outermost plates (fig. 14) of the usual modified form, sometimes rather irregular (fig. 13).

The (about 7 mm.) long, ribband-formed salivary glands through their white color contrasted with the green of the adjacent viscera; in their foremost part broader, having a breadth of about 0.6 mm., in the rest of their length thin.

The liver grayish-green, about 5.5 mm. long, by a breadth of 4 and a height of 3 mm.; the substance more yellow. The heart and especially the renal region, of greenish color. The sanguineous glands greenish, much flattened; the anterior linguiform about 1.75 mm. long, with a breadth of about 0.6 mm.; the posterior of about the same length, a little broader. The anterior genital mass small, about 2.5 mm. long, by a breadth and a height of 1 mm., of blue-green color, as were the different component organs of the mass. The spermatheca as usual, spherical; the spermatocysta shorter than in the former species. The penis as in other species.

CADLINA, Bergh.

Corpus sat depressum; dorsum granulatum, vix asperum; branchia retractilis, e foliis tripinnatis paucis formata; caput parvum tentaculis brevibus, applanatis, triangularibus quasi; podium sat latum, sulco marginali anteriore profundo.

Armatura labialis lamelliformis, fere annuliformis, e hamulis minutissimis formata.

Radula rhachide dente denticulato armata, pleuris multidentatis; dentes laterales hamati, externo margine serrulati.

Glans penis hamulis seriatis armata.

This genus has been established for a group of *Dorididæ* with the *D. repanda* (A. et H.) as type. The *Cadlinæ*¹ have a somewhat depressed body with rather broad mantle-edge; the back is rather finely granulated; the gills retractile, consisting of few tripinnate leaves; the opening orifices for the rhinophoria subcrenulate; the head small, fitting in a groove of the mantle; the tentacles short, lobe-formed; the foot rather broad, with a strong furrow in the anterior margin. The nearly annular lip-plate

¹ Laxdåla Saga; Hafnia, 1826, p. 123.

formed of densely set (bifid) hooks. The rhachis of the tongue with a depressed plate with a low denticulated hook; the pleuræ with a series of hook-shaped teeth, the inner denticulated on both edges; the outer only on the exterior margin. The glans penis armed with rows of small hooks. A spoon shaped process at the upper wall of the vestibulum.

Alder and Hancock have given some notes on the nervous and genital systems and on the structure of the radula of the typical species, which has also been the subject of some observations by Meyer and Möbius.

Up to the present time only three species of the genus are known, two belonging to the northern part of the Atlantic, the third to that of the Pacific; nothing is known of their spawn or their biology.

1. *Cadlina repanda* (A. & H.). Oc. Atlant. sept.

2. *Cadlina glabra* (Friele & Hansen).

Doris glabra, Fr. & Hans., l. c. p. 2. Oc. Atlant. sept.

3. *Cadlina Pacifica*, Bergh, n. sp. Oc. Pacific. sept.

1. *Cadlina repanda* (A. & H.). Pl. V. fig. 15; Pl. VI. figs. 21, 22; Pl. VII. figs. 9-18; Pl. VIII. figs. 3-6.

Doris repanda, A. & H. Monogr., Part III., 1846, Fam. I. pl. 6; Part V., 1851, Fam. I. pl. 1, figs. 10, 11; pl. 2, fig. 14, Part VI., 1855, app. p. II. pl. 46, suppl. fig. 7.

Hancock and Embleton, Anat. of Doris, Phil. Trans., 1852, II. p. 212, 215, 219, 233, Pl. XI. fig. 3; Pl. XII. figs. 11-13; Pl. XIV. fig. 5; Pl. XV. fig. 5; Pl. XVI. fig. 10; Pl. XVII. fig. 9.

Meyer and Moebius, Fauna der Kieler Bucht, II. 1872, p. 68, Taf. fig. 1-7.

Doris lævis, Fleming. Brit. Anim., p. 282, 1828.

Doris obvelata, Lovén, Ind. Moll. Scand., p. 4, 1846. Sars, Reise til Lofoten og Finmarken, p. 76, 1851.

Color lacteus vel luteus, limbo palliali supra maculis luteis vel lacteis distinctus.

Branchiæ e foliolis quinque compositæ.

Hab. M. Atlant. sept.

It is useless to discuss the question, if the *D. lævis* Linné represents this species; if this in reality was the case, the name of Linnæus ought to be re-established, as it has been done by Mörch¹ (*Acanthochila lævis*, M.). It is scarcely worth while

¹ Cf. Mörch, Faunula Moll. Islandiæ, Naturh. Foren. vidensk. Meddel. 1868, p. 202.

to try to determine, if the *D. lævis* should happen to be the *D. obvelata* of O. Fr. Müller, as supposed by Lovén.¹ In many cases the authors of the present time are unable to determine the species described by authors of late date; it is in most cases still more impossible to determine the species described by elder authors. Better to leave those names of the past to oblivion. Science, after all, ought not to take notice of any Nudi-branchiate, that was not anatomically examined; as without such examination it is in many cases not possible even to determine the genus, to which in reality the species belongs. The form described and figured by Alder and Hancock as *D. repanda* is on the contrary determinable, and this name ought to be preserved, although perhaps identical with the elder denominations of Linné and of Müller.

Of this species I have had five specimens for anatomical examination; two kindly sent me by Mr. Friele, of Bergen, and obtained in that vicinity; two from Samso, Kattegat, and from the Island of Zeeland (Denmark), and one from the neighborhood of Kiel, for which I am indebted to the friendship of Prof. Moebius; the individuals agreed in their internal and external structure.

The color of alcoholic specimens was uniformly white or yellowish-white. The Norwegian specimens were 11–19.0 mm. long, 6.5–8.0 mm. broad, and 3.5–6.0 mm. high. The breadth of the foot was 2.6–4.5 mm., of the mantle-edge 1.5–2.5 mm.; the height of the rhinophoria 1.2–2.0 mm., of the gill 1.5–2.5 mm.; the corresponding measurements of the Danish specimens were 20.0–23.0, 14.0–15.0, 8.–9.0, 4.–6.0, 3.5–3.75, and about 2.0 and 3.0 mm. The length of the individual from Kiel was about 8.0 mm.

The form was rather depressed, the outer part of the mantle-edge not thick. The back was covered all over with small and very small papillæ, obtuse or more pointed, low and rounded.²

The rhinophorial orifices were not prominent, but were slightly crenulated on the margin. The club showed fifteen to twenty

¹ Lovén, Ind. p. 4: "*D. obvelata*, M. (non C. Fabr. non Johnston, non Bouch. Chant.)—*D. repanda*, A. & H. Mörch, on the contrary (Faun. Moll. Isl., p. 202) regards the *D. obvelata*, Möller (Ind. Moll. Grönl.) non Müller, as identical with the *D. repanda* of Alder and Hancock.

² No trace of the characteristic yellow spots was to be seen on the mantle-edge.

leaflets.¹ The opening of the branchial cavity rather small (diameter 1.5–2 mm.) round, not prominent, with a reflexed and scarcely crenulated margin. The gill consisted of five tripinnate leaflets,² the anterior median hardly smaller than the others. The two anterior laterals were often cleft so as to simulate two plumes. The anal tube was short, truncate, situated between the two posterior branchial plumes, the renal orifice at the right side.

The head was small, consisting of the mouth and two small flattened tentacles, with a furrow along their outer margin. The flattened genital papilla furnished with a rather contracted orifice; in its upper part always a more or less (1.0 mm.) projecting triangular or spoon-shaped lobe (figs. 21, 22). The foot straight or a little rounded in the forepart, strongly grooved in the margin; the upper lip slightly cleft in the median line.³ The peritoneum colorless. The five individuals were dissected.

The central nervous system showed the cerebral ganglia of rounded-triangular form, sometimes somewhat elongated, larger than the visceral ones, which are more rounded. In connection with the hind part of the under side of the right cerebral ganglion was a small rounded ganglion (of about 0.07 mm. diameter) prominent between the hinder part of the cerebral ganglia, and giving off a long nerve backwards. In connection with the anterior part of the upper side of the cerebral ganglion was an optic ganglion, a little smaller than the former; the *n. opticus* rather short. In connection with the posterior part of the under side of the visceral ganglion through a rather short nerve is an oblong *ganglion genitale*,⁴ giving off a long nerve to the anterior genital mass (penis?); the ganglion containing cells of rather unequal size. The pedal ganglia are situated perpendicularly or oblique to the former, and a little compressed. The commissure rather broad and short, as long as the largest diameter of the pedal ganglion; the proximal olfactory ganglion bulbiform, very short stalked, a little smaller than the buccal ones. No true distal was observed. The visceral

¹ According to A. and H. the number of leaflets is twelve to thirteen, and to Meyer and Moebius fourteen.

² Both A. and H. and Meyer and Moebius mention five plumes.

³ The markings on the under side of the mantle-brim (cf. Alder and Hancock, l. c. fig. 2) were not visible.

⁴ This ganglion had already been seen by Hancock and Embleton (l. c. Pl. XVII. fig. 9).

ganglia were of oval form, connected by a very short commissure; the gastro-oesophageal oblong, about one-eighth the size of the last, short stalked, developed on the side of the nerve; with a single large and several small cells.

The eye showed a yellow lens and deep black pigment. The otocysts visible as chalk-white spots under the loop in the usual position, with about one hundred otoconia of the ordinary kind. There were sparingly scattered calcified spiculæ, 0.25–0.30 mm. long, in the broad and rather thick leaves of the rhinophoria, set perpendicularly or obliquely on the free margin of the leaves. The skin was profusely furnished with large and small rod-shaped spiculæ, mostly much calcified; in the axes of the granules of the back were bundles of perpendicular spiculæ as usual. In the interstitial connective tissue a very few large spicules.

The oral tube was wide (1.0–2.5 mm. long). The *bulbus pharyngeus* of the usual form, about 1.3–2.25 mm. long, 1.2–2.0 mm. broad, and 1.0–1.75 high. The radula also projected 0.3–0.75 mm. from the posterior part of the under side of the *bulbus*. The true mouth of triangular form, the point upwards. The lip-plate was deep horn-yellow, narrow at the upper end and broader downward at the lowest square part about 0.66 mm. broad; it is composed of densely set hooks, cleft at the point and rising to the height of about 0.033 mm. (figs. 9, 10). The tongue broad and flat; in the five individuals examined, furnished with twenty-six, twenty-seven, thirty-six, thirty, and fifteen rows of teeth; further backwards thirty-three, thirty-four, twenty-eight, thirty-six, and thirty-two rows developed, and four immature rows; the total number of rows sixty-three, sixty-five, sixty-eight, seventy, and fifty-one.¹ The basal plate of the teeth rather broad (fig. 16), the hook standing nearly perpendicular on it. The median tooth (figs. 11a, 12a, 13) broader on the posterior margin; the cutting edge of the recurved hook with three to four denticles on each side. The lateral plates² in two individuals number only twenty-two to twenty-three; in three others twenty-five to twenty-six on the hind part of the tongue, and further backwards twenty-eight to twenty-nine; the three to four foremost rows were always very

¹ According to Alder and Hancock the number of rows is sixty-eight. I found the lowest number in the small individual from Kiel.

² The number was according to Alder and Hancock twenty-two, and to Meyer and Moebius eighteen.

incomplete. The first plate with seven to nine denticles at the outer side of the hook, and with three to four on the inner side (figs. 11*bb*, 12*bb*). The second and third (fig. 14) with broad basal plate, as (figs. 14, 3) also all the succeeding plates without denticulation of the inner margin; on the outer edge (Pl. V., fig. 15) a certain number of denticles, increasing to twenty or twenty-five. In the outermost part of the rows the number of denticles decreased (fig. 15); the outermost plates were of very variable form (figs. 15*a*, 4*a*). The height of the outermost plate sometimes only 0.007, generally 0.04–0.05 mm., the height of the next plate about 0.06, of the next 0.075 mm.; the height rising to about 0.1 mm.; the height of the innermost lateral plate 0.04, of the fifth 0.06 mm. The color of the plates was pale yellow, the outermost colorless.

The salivary glands strong, whitish or yellowish, flattened, with a breadth of 1.5 mm., forming two to three short coils at the sides of the *œsophagus*; the duct very short. The *œsophagus*, as usual, also the stomach. The intestine emerging from the liver (fig. 17*a*) behind the middle of its upper side; the first part proceeding towards the fore end of the liver, in the largest individuals about 5.8 mm. long, somewhat wider in the pyloric part, the descending part of the intestine nearly 13–17 mm. long, with a nearly constant breadth of 0.75–1 mm. The liver (in the largest individuals) about 1.3–15.0 mm. long, by a breadth of 7–7.0, and a height of 6–7.5 mm.; about half of the light anterior part strongly flattened for the reception of the anterior genital mass, the posterior end rounded; the color of the surface yellowish-white, the substance (when cut) yellow. The biliary sac whitish, very distinct (fig. 17*b*) on the surface of the liver, about 2 mm. long, laying at the anterior end of the pyloric part of the intestine, on the right side.

The heart and renal chamber as usual; the last white, very large, reaching to the fore-end of the liver. The sanguineous gland whitish, very flattened, about 3.5–5.0 mm. in largest diameter, covering the central nervous system. The yolk-yellow hermaphroditic gland covering the upper and right side of the liver (fig. 17*cc*) occasionally with groups of lobes scattered on the under side, but never forming a nearly continuous layer over the liver. The structure was as usual, with large oögene cells and zoöspers in the lobules. The anterior genital mass large, in the largest specimens 8–8.5 mm. long, 3.5–4.0 mm. broad, and

6-7.0 mm. high, ovoid, plano-convex, flattened on the left side. The ampulla of the hermaphroditic duct usually crossed over the left side, whitish, sausage-shaped, 6-7.0 mm. long, by 1.1-2.0 mm. in diameter. The windings of the spermatoduct rested on the anterior margin of the genital mass, the first part thicker but not much longer than the rest, which was thinner and stronger (in the largest individual 7-10.0 mm. long). A stricture unites the two parts, the last passing without definite limits into the nearly cylindrical or elongate-conical (retracted) penis, which was about 1.5-2.5 mm. long, the somewhat elongated glans being straight or curved, 0.5-0.6 mm. in length, by 0.08-0.1 mm. in diameter (fig. 18). It was furnished with irregularly set (fig. 5) rows of pale-yellowish hooks, which rose to a height of about 0.016 mm. They were straight or curved, sometimes irregular or connate (figs. 5, 6), mostly solitary, yet sometimes arranged in small groups (fig. 6); the sperm duct continued (fig. 18a) through the whole length of the glans to the round orifice on the point of the glans; there was no continuation of the armature of the glans backwards over a longer portion of the sperm duct. The spermatheca spherical, about 2-3.0 mm. diameter; its own duct a little longer than the leg, rather wide, then uniting with the thinner and somewhat longer (and wider at the union) duct of the *spermatocysta*, which was also round and of the diameter of 1-1.5 mm.; both organs resting upon the anterior margin of the mucus gland; the vagina about as long as, and a little wider than, the special duct of the spermatheca.¹ The large mucous gland yellowish-white or yellow; the opaque part on the upper part of left side yellow or brownish; the cavity empty.

2. *Cadlina pacifica*, Bergh, n. sp. Plate VII. figs. 19, 20; Pl. VIII. figs. 7-18.

Color cærulescente albidus.

Branchia e foliolis novem composita.

Hab. Oc. Pacific. sept. (Captain's Bay, Unalashka, and Coal Harbor, Shumagin Ids.).

Dall obtained a living specimen of this species at Captain's Bay, Unalashka, in May, 1872, at low water and on rocky bottom. The color of the living animal he states to have been "bluish-white."

The alcoholic specimen was of a uniform yellowish color, with

¹ Hancock and Embleton, l. c. 1852, Pl. XV., fig. 5.

a slight tinge of olive. The rhinophoria and branchiæ of deeper yellow. It was about 28.0 mm. long, 13.0 mm. broad, and 7.0 mm. high; the foot 7.0 and the free mantle edge 3.0 mm. broad. The rhinophoria 2.5 mm. and the branchial leaflets 3.5 mm. high. It was of rather depressed elongate form; the mantle margin rather broad. The back covered all over with rather small compressed or rounded densely set tubercles, which often coalesced, forming short longitudinal folds. These nearly disappeared at the margin of the mantle. The rhinophorial orifices situated rather forward with several tubercles on their margins, the club of the rhinophoria with twelve to fifteen large and very oblique leaves. The opening of the branchial cavity (the branchial leaves retracted) was a longitudinal slit of about 4 mm. in length, and rather narrow; the margin of it with tubercles of the usual kind. The branchial leaves nine in number, four lateral pairs and one anterior unpaired, tripinnate. The anal tube low, with two (lateral) lips (fig. 19); the renal pore in front of and at its right side. The outer mouth a small longitudinal slit; the tentacles very small, with a furrow at the upper part of their outer margin. The under side of the mantle edge even; a small deep groove for the head. The sides of the body rather low; the genital opening round, with at least two openings in its depth. The foot rounded at the fore end with traces of a fine furrow, the posterior end somewhat pointed.

The intestines were visible through the skin. The peritoneum colorless, nearly without spicula.

The central nervous system showed the cerebral and the visceral ganglia very distinct; the cerebral short, reniform, a little broader in the anterior part, a little larger than the buccal, bulbiform, short-stalked; the optic ganglia scarcely equal to one-tenth of the size of the latter; the optic nerve short. The visceral ganglia short, pyriform; on the under side of the right hand are a short-stalked genital ganglion, intermediate in size between the optic and olfactory ganglia. The pedal ganglia nearly perpendicular on the under side of and a little smaller than the visceral. The commissures rather short, the visceral nearly free from the broad subcerebro-pedal.

The buccal ganglia rounded and connected by an extremely short commissure. The gastro-œsophageal short stalked, ovoid,

about one-eighth the size of the former, developed on one side of its nerve with one very large and several smaller cells.

The eye provided with black pigment, and a yellow lens. The otocysts in their usual place, filled with ordinary otoconia. The broad leaves of the rhinophoria with a rather large quantity of spicula, generally set obliquely or perpendicularly on the free margin. The spicula mostly rod-shaped, long, and much calcified. These also occur abundantly in the skin of the back, often associated in small groups. The tubercles of the back were stiffened in the ordinary way, but there were very few spicules of the larger kind in the interstitial tissue.

The oral tube was about 2.5 mm. long, 1.8 mm. wide at the posterior end, internally as usual; the retractor muscles very strong. The *bulbus pharyngeus* strong, about 3.0 mm. long, 2.5 mm. broad, and 2.1 mm. high. The sheath of the radula projecting about 1 mm., bent upwards. The lip-disk rather broad; the lip-plate broad, broadest below, yellow; the lateral parts with several transverse folds; the elements (fig. 7, 8) scarcely different from those of the typical species, or perhaps a little less crooked, of a height of about 0.05 mm.; the mouth, of triangular form, quite as in the *C. repanda*. The tongue of usual form with about thirty-three rows of plates; further back forty-eight developed, and four immature rows; the total number of them eighty-five; the first ten rows of the tongue more or less incomplete.¹ The number of lateral plates in the hinder row of the tongue thirty-three, the number scarcely increasing in the sheath. The plates of yellowish color; the breadth of the oldest plate (in the hinder part) 0.045 mm., the breadth of these plates increasing to 0.06 mm.; the height of the outermost plates about 0.04, and the height of the lateral plates increasing to about 0.12 mm. The plates of nearly the same form as in the last species. The median plate a little emarginated in the posterior margin; the short recurved hook usually with 3-4 denticles on each side of the point (fig. 9, 10a), sometimes this point was replaced by two single or bifid larger denticles (fig. 9). The first lateral plate (fig. 10bb) with 5-6 denticles at the inside, and with 6-7 at the outside of the hook. Through the 4-6 following plates (fig. 10) the size of the plates

¹ The progression was as follows, 6-1-1, 4-1-3, 6-1-7, 10-1-12, 20-1-18, 22-1-19, etc.

and the number of denticles did not much increase, after which both gradually increased as usual (figs. 11-13). Still the number of denticles in the individual examined hardly exceeded 18-22, and was still smaller in the outer portion of the rows (fig. 15). The three or four outer plates were of rather variable form (figs. 14-15) generally without denticles or only traces of them (figs. 14aa, 15a).

The salivary glands were yellowish, flattened, riband-shaped, 10.0 mm. long, with a greatest breadth in the anterior part of 1.0 (fig. 20); the glands adhering to one another through more than the posterior half; the ducts short (fig. 20a). The œsophagus about 9.0 mm. long, rather thin, and somewhat broader in the middle. The stomach narrow. The intestine appeared at the surface of the liver behind the middle of that organ, was about 5.5 mm. long, reaching to the second fifth of that organ. The reflected part was about 14.0 mm. long, and the alimentary cavity was empty.

The liver 14.0 mm. long, reaching 6.0 mm. in breadth and 5.3 mm. in height. The posterior end rounded, somewhat pointed, more than half the right anterior portion flattened for the anterior genital mass. The surface was grayish-yellow, the substance deeper yellow. The *vesica fellea* smaller than in the typical species, appearing at the right side of the pyloric part of the intestine with a rounded upper end about 1.5 mm. in diameter.

The heart as usual. The sanguineous gland whitish, flattened; about 6 mm. long, with a breadth in the posterior half of 3.5 mm. in the anterior of scarcely 2.0 mm., its thickness about 0.5 mm., covering the largest part of the central nervous system. The urinary chamber large.

The hermaphroditic gland yolk-yellow, spread over the forepart of the liver, over the anterior part of its upper side and over the lateral parts of this organ; in its lobules were large oögene-cells. The anterior genital mass large, about 9.5 mm. long, nearly 6.5 mm. high, and 4.5 mm. broad, oval plano-convex. The yellowish hermaphroditic duct issued from about the middle of the applanation on the forepart of the liver, rather strong, swelling into the yellow ampulla that runs in short windings over the left side of the anterior genital mass to its anterior end; the length of the unrolled ampulla was about 9.0 mm., its diameter only 0.1 mm. The spermatoduct with its windings resting on the ante-

rior margin of the genital mass; its first part about 15.0 mm. long with a diameter of about 1.0 mm., yellowish, passing through a slight stricture into the second, which has only half the length and half the diameter and is of a paler color. The penis nearly 4.0 mm. long, and 1.5 mm. in diameter. The glans in the upper end of the cavity having a length of nearly 1.0 mm. (fig. 17); the cuticula clothing the inside of it seemed to present hooks similar to those in the typical species, but fewer and thinner (fig. 18). The *spermatheca* spherical, about 3.0 mm. in diameter; its duct as usual. The spermatocysts spherical, about 1.6 mm. in diameter. The ducts as usual, the cavity filled with sperma. The mucus gland large, whitish, and yellowish-white; on the anterior part of the left side was a yolk-yellow mass, the large cavity empty. The spoon-shaped lobe in the vestibulum had a length of nearly 2.0 mm.

Since the above observations were made two other individuals of the same species have come under my notice. They were obtained by Dall in September, 1872, at Coal Harbor, Shumagin Islands, Alaska, on a muddy beach at low water. The color of the living animal was "bluish."

The specimens in spirits were 8.0 and 14.0 mm. long, 6.0 and 10.0 mm. broad, 3.5 and 5.0 mm. high respectively, and of yellowish color. The form as above.

The opening of the retracted gill transversely oval, as above mentioned, the gill with 8-9 leaves. The anal papilla as above. Both specimens were dissected.

The central nervous system, the eyes, the oto-cysts, and the skin quite as above mentioned. The oral tube about 1.5 mm. long. The *bulbus pharyngeus* in the largest individual about 1.75 mm. long, and 1.5 mm. broad and high. The sheath of the radula rather prominent, bent upwards. The mouth-slit triangular; the lip-plates chocolate-brown in the larger, yellow in the smaller individual; the structure as usual. The hooks in general a little thicker at the point. The tongue with twenty-seven to thirty rows of plates; further backwards thirty-six to thirty-nine freshly developed and four immature rows; the total number of rows was sixty-seven to seventy-three rows. In the posterior rows of the tongue twenty-seven to thirty plates. The plates as previously mentioned; the median tooth (fig. 9) merely broader in the hind part of the basal plate

The salivary glands, the œsophagus, the stomach, and the intestine as above. The liver was in length 8.5, in breadth 4.25, and in height 4 mm.; the applanation on the right anterior part shorter than above. The *vesica fellea* as above. The sanguineous gland and the urinary chamber as above.

The hermaphroditic gland with its yellow lobes clothing the largest part of the fore-end and the upper side of the liver. The anterior genital mass about 4.5 mm. long, 3.0 in height, and 2.0 mm. broad. The ampulla of the hermaphroditic duct as above, also the spermatoduct and the penis, which was about 2.0 mm. long. The glans short, its opening and interior clothed with an armature; this last only extended over a total length of about 0.8 mm.; the hooks (fig. 18) pale yellowish, as above, rising to a height of about 0.016 mm. The spermatheca and spermatocysta as above, and also the spoonshaped lobe in the vestibulum.

Note. Should the reader find any errors of proof-reading in the preceding paper, he will bear in mind that Dr. Bergh has not been able to correct the proofs in person and make due allowances, though it is hardly necessary to remark that the utmost pains have been taken to avoid any such errors.—W. H. D.

EXPLANATION OF PLATES.

An asterisk denotes that the drawing is by camera lucida, the fraction denotes the magnification.

PLATE I.

Aeolidia papillosa (L.) var. *Pacifica*.

1. Mandible from the inside,* $\frac{5.5}{1}$; *a*, *crista connectiva*; *b*, *processus masticatorius*.
2. Part of the masticating edge,* $\frac{3.50}{1}$.
3. Two teeth from the radula,* $\frac{2.00}{1}$.
4. Another from the side,* $\frac{3.50}{1}$.
5. Penis; *a*, *ductus ejaculatorius*.
6. Cnidæ,* $\frac{3.50}{1}$.

Fiona marina (Förskal) var. *Pacifica*.

7. Two teeth from the radula from above,* $\frac{3.50}{1}$.
8. The hook of the same,* $\frac{3.50}{1}$.

Hermisenda opalescens (Cooper).

9. Mandible,* $\frac{5.5}{1}$; *a*, *crista connectiva*; *b*, *process. mastic.*
10. Part of the masticating edge;* *a*, superior (anterior) part; *b*, posterior part, $\frac{3.5.0}{1}$.
11. Inferior margin of the hook of a tooth,* $\frac{3.5.0}{1}$.
12. Cnidæ,* $\frac{3.5.0}{1}$.

Coryphella sp.

13. Hind part of masticating edge from the inside;* *a*, posterior part, $\frac{3.5.0}{1}$.
14. Part of the radula;* *aa*, lateral teeth, $\frac{3.5.0}{1}$.

Flabellina iodinea (Cooper).

15. Anterior part of the posterior third of the masticating edge,* $\frac{3.5.0}{1}$.
16. A lateral tooth, from the side,* $\frac{3.5.0}{1}$.
17. A lateral tooth,* $\frac{7.5.0}{1}$.

Dendronotus purpureus, Bergh.

18. Elements of the prehensile collar,* $\frac{7.5.0}{1}$.
19. Part of the middle of the collar,* $\frac{7.5.0}{1}$.
20. Elements of the posterior part of the collar,* $\frac{7.5.0}{1}$.

Dendronotus Dalli, Bergh.

21. Exterior part of a row of teeth;* *a*, outer tooth, $\frac{3.5.0}{1}$.

PLATE II.

Hermisenda opalescens (Cooper).

1. Three plates of the radula, from one side,* $\frac{3.5.0}{1}$.
2. Two ditto, a little oblique, from above,* $\frac{3.5.0}{1}$.
3. Two of the anterior teeth,* $\frac{7.5.0}{1}$.
4. The hook of the hindmost developed plate,* $\frac{7.5.0}{1}$.
5. A lobe of the hermaphroditic gland,* $\frac{1.0.0}{1}$; *a*, efferent duct.
6. Penis; *a*, spermatoduct; *bb*, *præputium*; *e*, glans with its orifice.

Coryphella sp.

7. The right mandible from the outside,* $\frac{5.5}{1}$; *a*, the articulation; *b*, the cutting process.
8. The hinder part of the cutting edge from the outside,* $\frac{3.5.0}{1}$; *a*, posterior part.

Dendronotus Dalli, Bergh.

9. The tongue and its muscular mass (*c*) from the side; *b*, radula ;
c, *tectum radulæ*.
10. The same from above; *a*, superior end of the radula; *bb*,
muscular masses of the tongue; *c*, end of the descending
sheath of the radula.
11. Anterior rhachidian tooth, from above,* $\frac{1.00}{1}$.
12. The same, from below,* $\frac{1.00}{1}$.

Dendronotus arborescens (O. F. Müll.).

13. Hinder part of the cutting edge;* *a*, youngest part, $\frac{3.50}{1}$.
14. Hook of a rhachidian tooth,* $\frac{3.50}{1}$.
15. A group of (5) follicles of the hermaphroditic gland, *a*, efferent
duct,* $\frac{1.00}{1}$.

Flabellina iodinea (Cooper).

16. Part of three rows of plates, from above;* *a*, rhachidian
b, lateral plates, $\frac{8.50}{1}$.

PLATE III.

Dendronotus arborescens (F.).

1. Four lateral teeth;* *aa*, doubled tooth, $\frac{3.50}{1}$.

Dendronotus Dalli, Bergh.

2. The left mandible from the inside;* *a*, *crista connectiva*; *b*,
superior process; *c*, *processus masticatorius*, $\frac{5.5}{1}$.
3. The same with the same lettering,* $\frac{5.5}{1}$.
4. A part of the masticating edge,* $\frac{7.50}{1}$.
5. Thirteen outer plates of one of the posterior rows of the
radula;* *a*, outermost plate, $\frac{3.50}{1}$.
6. A rhachidian tooth or plate from behind, $\frac{3.50}{1}$.

Dendronotus purpureus, Bergh.

7. The masticating process;* *a*, the point, $\frac{1.00}{1}$.
8. Median plate from the upper side,* $\frac{3.50}{1}$.
9. Two median plates from the under side,* $\frac{3.50}{1}$.
10. The serrations of the right side of the median plate,* $\frac{7.50}{1}$.
11. Three lateral plates,* $\frac{7.50}{1}$.
12. (*a*) Anterior part of the salivary gland;* *b*, duct, $\frac{1.00}{1}$

Tritonia tetraquetra (Pallas).

13. *aa*, the foot; *b*, the corner of the frontal veil; *c*, margin of the genital opening; *d*, penis with the opening of the mucus gland under its root.
14. A branchial leaf or plume.
15. *a*, the anal papilla; *b*, the renal pore.
16. Part of the cutting edge of the *processus masticatorius*, $\frac{3.5.0}{1}$.

PLATE IV.

Dendronotus arborescens (O. F. Müller).

1. Masticating edge of the jaw, posterior end,* $\frac{3.5.0}{1}$.
2. Elements of the prehensile collar,* $\frac{3.5.0}{1}$.
3. Point of the penis; *a*, orifice,* $\frac{3.5.0}{1}$.
4. Penis;* *d*, vas deferens; *b*, point of the organ, $\frac{5.5}{1}$.

Tritonia tetraquetra (Pallas).

5. Part of the cuticle of the frontal veil.
6. The buccal ganglia, with *b* the right gastro-oesophageal ganglion,* $\frac{5.5}{1}$.
7. The mandibles from in front;* *a*, articulation; *b*, *processus masticatorius*.
- 8, 8. Teeth from the middle of the radula, parts of three rows, seen obliquely from above;* *aa*, median teeth; *bbb*, first laterals from the left side; *cc*, same of the right side; *dd*, second laterals of the left side, $\frac{3.5.0}{1}$.
9. Lateral teeth from the middle of a row,* $\frac{3.5.0}{1}$.
10. Outer teeth (6-9) of two rows;* *aa*, the outermost; *b*, fold of the cuticula, $\frac{3.5.0}{1}$.
11. Outer teeth (5-4) of two rows; *a* and *b* as above, $\frac{3.5.0}{1}$.
- 12, 12. Doubled (monstrous) teeth of two rows,* $\frac{3.5.0}{1}$.

Akiodoris lutescens, Bergh.

- 13, 13. Spicula of the skin.*

PLATE V.

Tritonia tetraquetra (Pallas).

1. Rhachis or median part of the radula, with part of three rows of teeth;* *aa*, rhachidian teeth; *bb*, first lateral teeth; *cc*, second laterals, $\frac{3.5.0}{1}$.

2. Middle part of a row;* *a*, rhachidian with 12 laterals; *b*, twelfth lateral, $\frac{350}{1}$.

Diaulula Sandiegensis (Cooper).

3. Papillæ of the back.
4. Outer part of two rows of teeth with 6-8 teeth;* *aa*, outermost teeth, $\frac{350}{1}$.
5. Inner part of two rows;* *aa*, first teeth, $\frac{350}{1}$.

Diaulula Sandiegensis (C.) var.

6. Two innermost teeth,* $\frac{350}{1}$.
7, 7. Outer part of two rows with 5 and 2 teeth;* *aa*, outermost, $\frac{350}{1}$.
8. *a*, first part of the spermato-duct; *b*, prostate; *c*, spermato-duct; *d*, penis; *e*, *vestibulum genitale*.
9. Penis opened with the glans and spermato-duct.

Lamellidoris bilamellata (L.) var. *Pacifica*.

10. Dorsal papillæ,* $\frac{100}{1}$.

Akiodoris lutescens, Bergh.

11. Dorsal papilla,* $\frac{100}{1}$.
12. Spicula from the rhinophoria,* $\frac{350}{1}$.
13. Glans penis from the side.
14. Glans penis from the end.

Cadlina repanda (A. & H.).

15. Lateral tooth from behind,* $\frac{750}{1}$.

PLATE VI.

Akiodoris lutescens, Bergh.

1. Median part of a row of teeth;* *a*, rhachidian; *bb*, first lateral; *cc*, second lateral; *d*, third lateral, $\frac{350}{1}$.
2. The rest of the same row;* *e*, the fourth tooth; *f*, the thirteenth, $\frac{350}{1}$.
3. The rhachidian tooth, obliquely,* $\frac{350}{1}$.
4. *a*, first, and *b*, second lateral teeth from one side,* $\frac{350}{1}$.
5. First tooth, anterior margin, from above,* $\frac{350}{1}$.
6. *a*, first, and *b*, second tooth from behind,* $\frac{350}{1}$.

- 7, 8. Third and fourth teeth from beneath,* $\frac{350}{1}$.
 9, 10. Fourth and fifth teeth obliquely from the side,* $\frac{350}{1}$.
 11. The fifth tooth from above,* $\frac{350}{1}$.
 12, 13. The seventh and eighth teeth from below,* $\frac{350}{1}$.

Akiodoris lutescens, Bergh, var.

14. Rhachidian tooth from below,* $\frac{350}{1}$.
 15. First lateral tooth of two rows,* $\frac{350}{1}$.
 16. The sixth tooth from one side,* $\frac{350}{1}$.
 17. *a*, the ventricle; *b*, the proceeding intestine; *c*, the biliary sac; *d*, the liver.
 18. *a*, yellowish part of the spermato-duct; *b*, thinner continuation; *c*, penis; *d*, duct of the spermatheca; *e*, vagina of vestibulum.
 19. *a*, spermatheca; *b*, spermatocysta; *c*, long duct of the mucus gland; *d*, duct of the vagina, directly continuous with *d* of fig. 18.
 20. Longitudinal section of the wall of the glans penis;* the hooks partly broken off and their sockets naked, $\frac{100}{1}$.

Cadlina repanda (A. and H.).

21. Spoon-shaped process of the upper part of the vestibulum from below.
 22. The same from above.

PLATE VII.

Akiodoris lutescens, Bergh.

1. Upper part of the interior of the glans;* *a*, outer wall, $\frac{100}{1}$.
 2. Part of the covering of the glans with its hooks,* $\frac{350}{1}$.
 3. Covering, with hooks, from the anterior end of the inverted part of the glans;* *a*, posterior; *b*, more anterior portions, $\frac{350}{1}$.
 4. Similar hooks from the anterior part,* $\frac{350}{1}$.
 5. Anterior end of spermato-duct and posterior part of the inverted penis;* *aa*, walls of the spermato-duct; *b*, end of the same; *c*, most posterior part of the penis with its hooks, $\frac{100}{1}$.
 6. Covering of the vagina with its rod-like palisades;* at *a* and other places they have been torn away, leaving only their stiff axes, $\frac{00}{1}$.

7. Similar covering with well preserved "palisades,"* $\frac{100}{1}$.
8. Elements of the same,* $\frac{350}{1}$.

Cadlina repanda (A. and H.).

9. Elements of the buccal plate from above,* $\frac{750}{1}$.
10. The same from the side,* $\frac{750}{1}$.
11. The median part of the radula;* *a*, median tooth; *bb*, first laterals, $\frac{750}{1}$.
12. The same with four median teeth,* *a* and *b*, as above, $\frac{750}{1}$.
13. A median tooth,* $\frac{750}{1}$.
14. Third lateral tooth from the side,* $\frac{750}{1}$.
15. Outer part of four rows, with one to three teeth;* *a*, outermost tooth, $\frac{750}{1}$.
16. Median part of the radula from below;* *a*, median teeth, $\frac{200}{1}$.
17. *a*, pyloric part of the intestine; *b*, the *vesica fellea*; *c*, lobes of the hermaphroditic gland.
18. Everted glans penis;* *a*, continuation of the armed cuticle of the anterior part; *b*, interior of the spermatoduct, $\frac{100}{1}$.

Cadlina Pacifica, Bergh.

19. The anal papilla.
20. Anterior part of the salivary gland; *a*, duct.

PLATE VIII.

Akiodoris lutescens, Bergh.

1. Part of the radula with three to six rows of teeth;* *a*, rhachidian tooth; *b*, first lateral; *c*, second; *d*, third; *e*, fourth, $\frac{350}{1}$.
2. The remainder of these three rows of teeth;* from *a*, the fifth, to the twelfth and outermost tooth, $\frac{350}{1}$.

Cadlina repanda (A. and H.).

3. The seventeenth to the twentieth teeth of two rows,* $\frac{750}{1}$.
4. The outermost teeth of seven rows,* $\frac{750}{1}$.
5. Part of the glans penis,* $\frac{750}{1}$.
6. Some of its isolated hooks,* $\frac{750}{1}$.

Cadlina Pacifica, Bergh.

7. Elements of the lip-plate or buccal plate.
8. The same in another part,* $\frac{750}{1}$.
9. Three rhachidian teeth,* $\frac{750}{1}$.
10. Median part of the radula;* *a*, median plates; *bb*, first laterals;
c, fourth lateral, $\frac{750}{1}$.
11. Side view of a lateral tooth from the outer side,* $\frac{750}{1}$.
12. The same from the inner side,* $\frac{750}{1}$.
13. Largest lateral tooth,* $\frac{750}{1}$.
14. Outer plates (teeth) of four rows;* *aa*, the outermost, $\frac{750}{1}$.
15. Four outer plates of one row;* *a*, the outermost, $\frac{750}{1}$.
16. Part of the cuticle with its spicula,* $\frac{350}{1}$.
17. The glans penis,* $\frac{100}{1}$.
18. Part of the penis,* $\frac{750}{1}$.

Jorunna Johnstoni (A. and H.).

19. Lateral tooth,* $\frac{350}{1}$.



1-6. *Aeolidia papillosa* (L.) var. *pacifica*.

7-8. *Fiona marina* (Forsk.).

9-12. *Hermisenda opalescens* (Cooper).

B. Bergh.

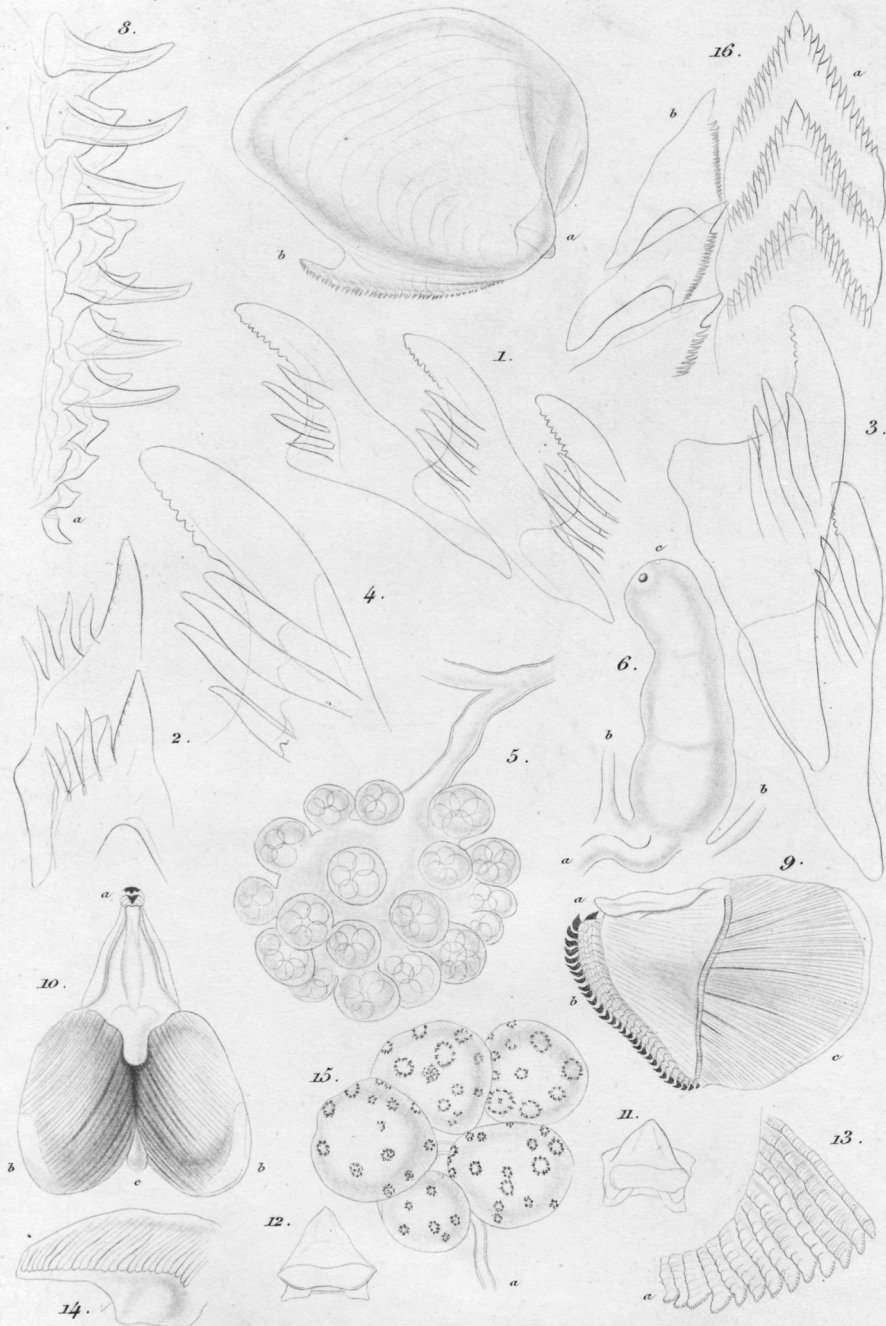
13-14. *Coryphella* sp.

15-17. *Flabellina iodinea* (Cooper).

18-20. *Dendron. purpureus*, Bgh.

21. *D. Dalli*, Bgh.

Jenny Hansen.



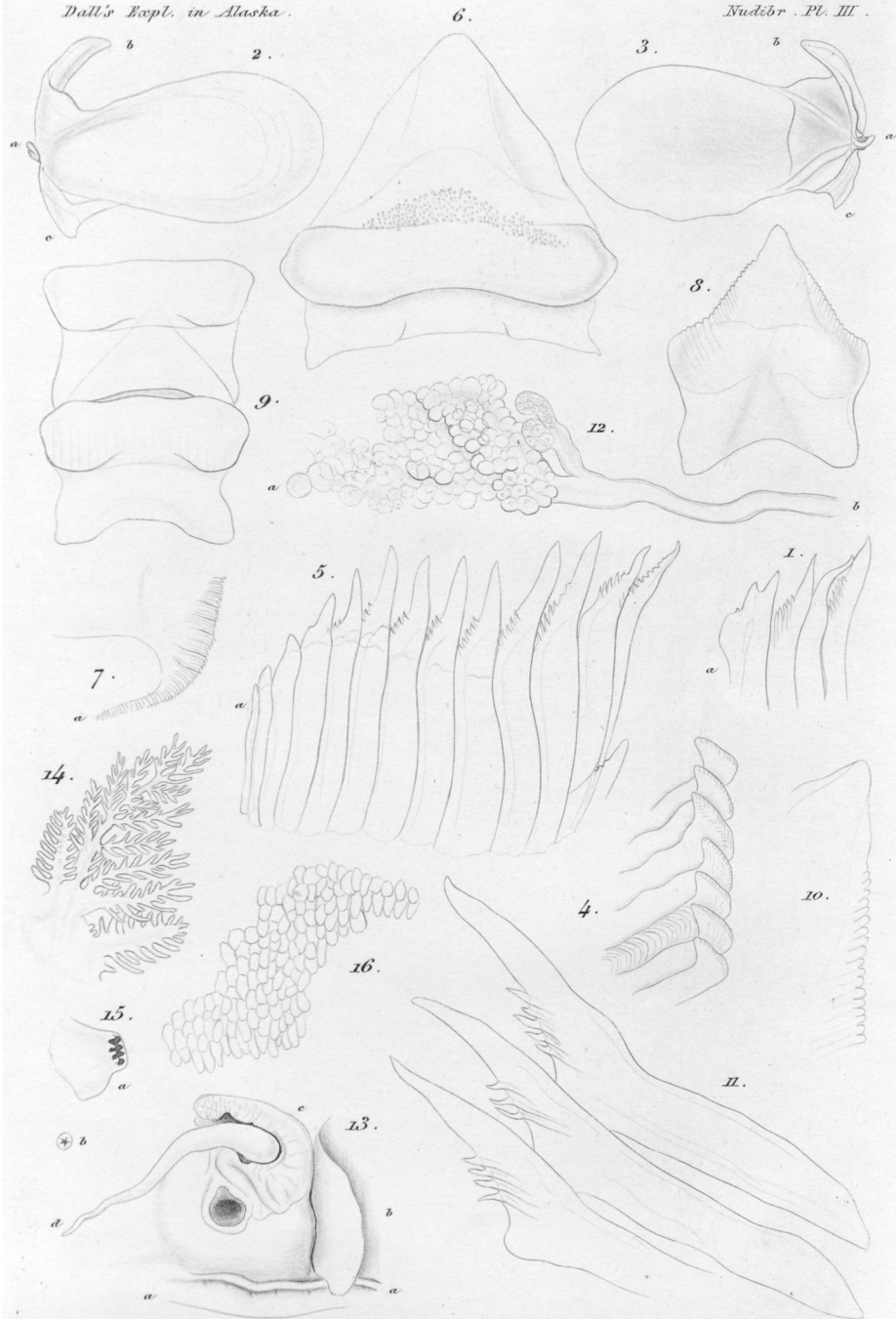
1-6 *Hermisenda opalescens* (Cooper).

7-8 *Coryphella* sp.

9-12 *Dendronotus Dalli*, Bgh.

13-15 *D. arborescens* (F.).

16 *Flab. iodinea* (C.).



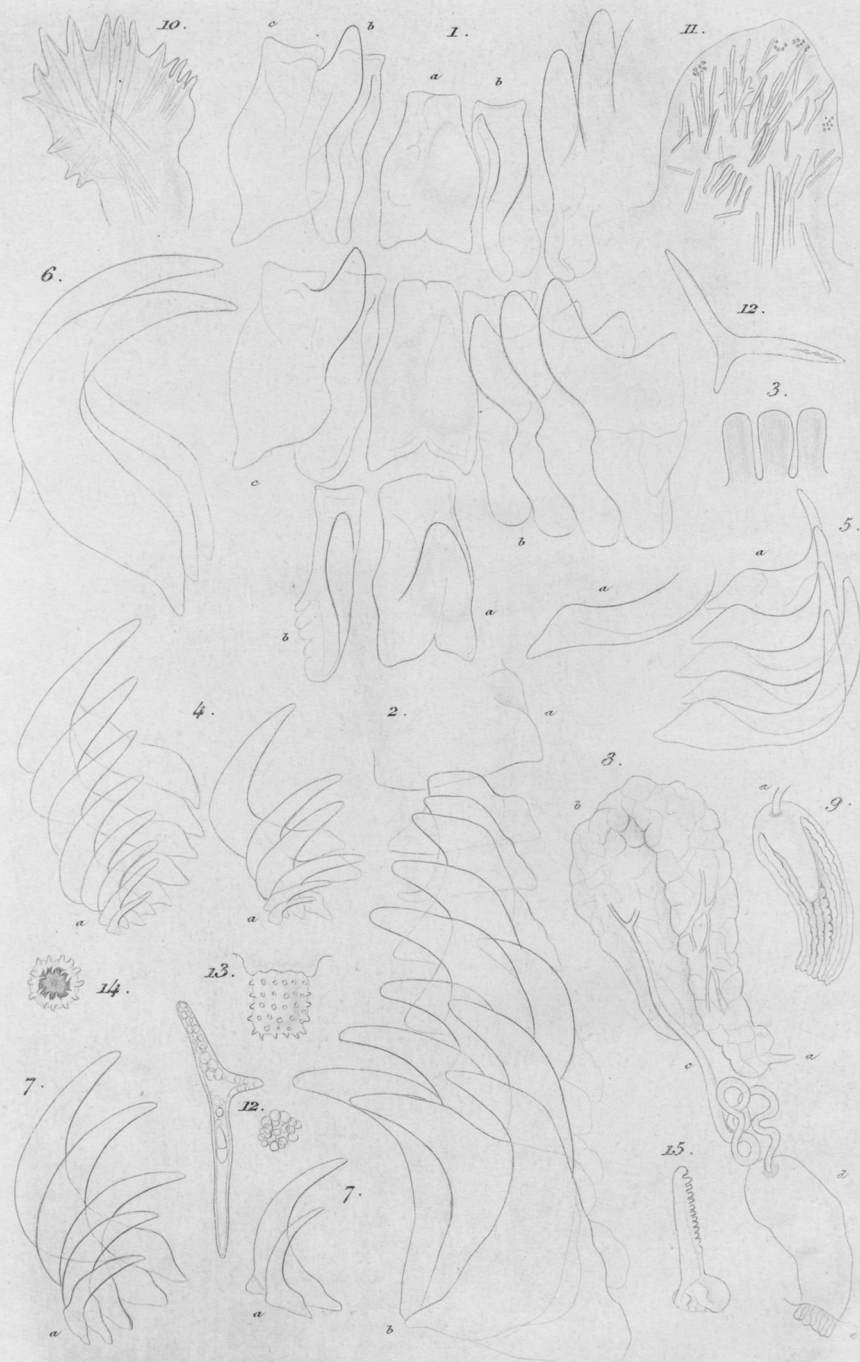
1. *Dendronotus arborescens* (F.). 7-12. *D. purpureus*, B.
 2-6. *D. dalli*, Bgh. 13-16. *Tritonia tetraquetra* (Pallas).
 R. Beyer. Jenny Hansen.

1-4. *Dendron. arbor. (F.)*. 5-12. *Trit. tetraquetra (P.)*.

R. Bergh.

13. *Akiod. lutescens*, Bgh.

Jenny Hansen.



1-2. *Tr. tetragetra* (P.)

3-9. *Diadula Sandiegensis* (Cooper).

10. *Lam. bilamell* (J.)

11-14. *Akied lutescens*, B.



1-20. *Akiodoris lutescens*, Bgh.

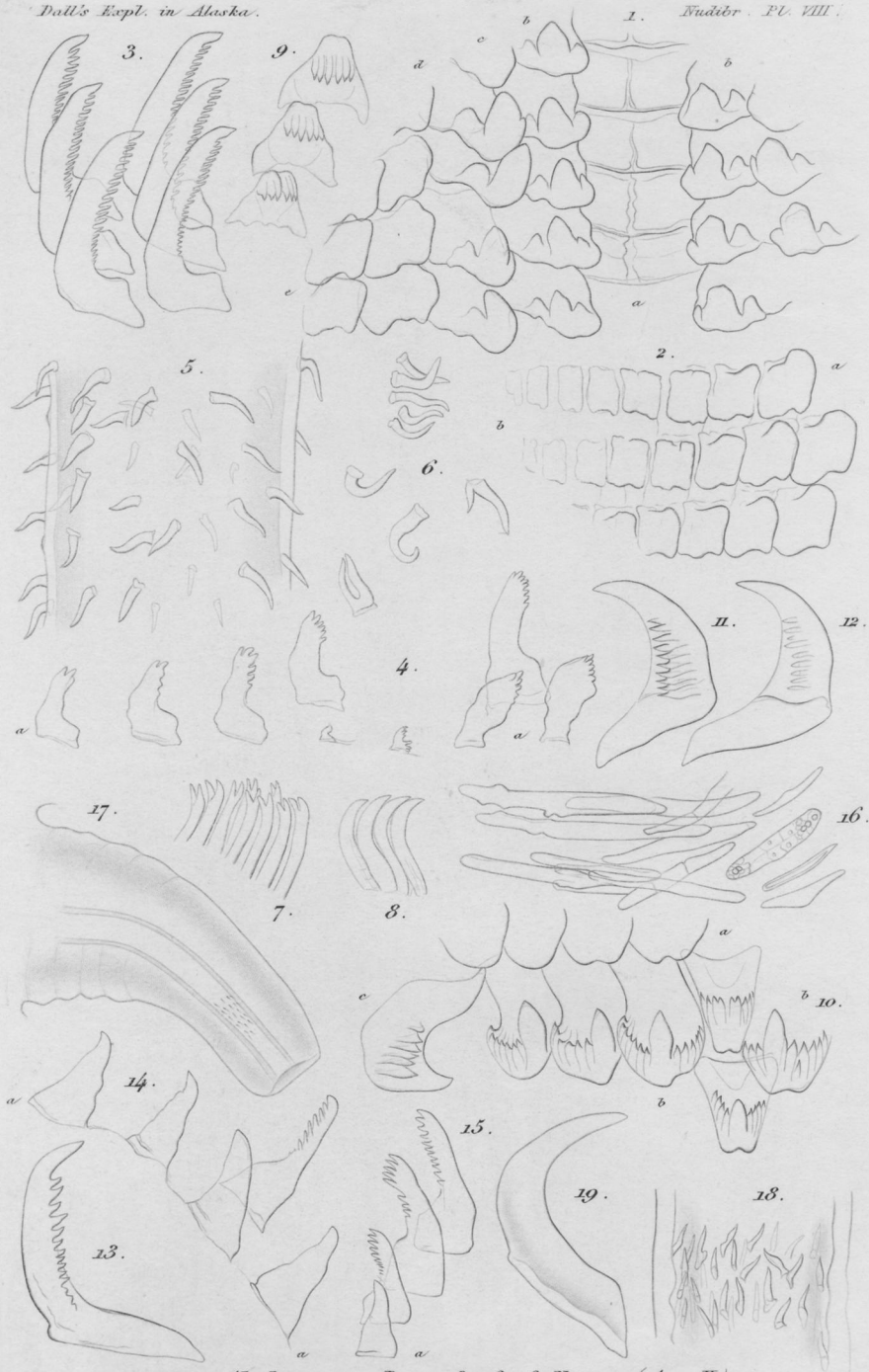
21-22. *Cudlina repanda* (A. et H.).

R. Bergh.

Joany Hansen.



1-8. *Akiod. lutesc.*, B. 9-18. *Cadl. rep.* (A et H.) 19-20. *C. pacifica*, B.
R. Rugh. Zuercher.



1-2. *Ak. lutescens*, B. 3-6. *Cadl. rep.* (A. et H.)

7-18. *C. pacifica*, B. 19. *Jorunna Johnstoni* (A. et H.)